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# THE LAWN

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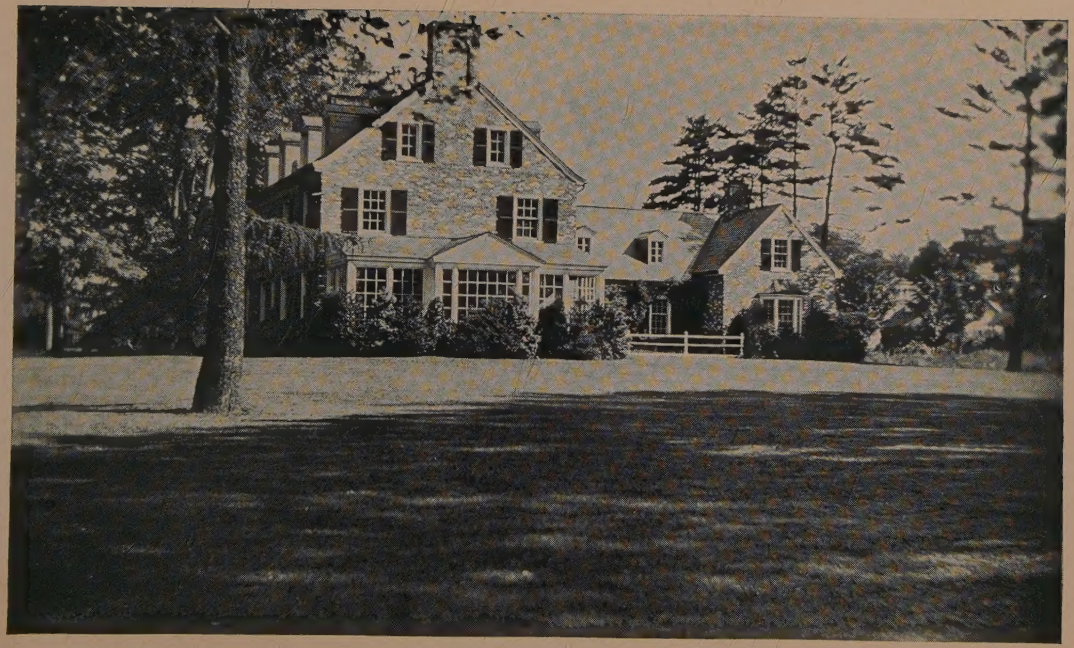

A COMFORTABLE HOME WITH A WORTHY LAWN. NOTE THAT THE LAWN IS ONE-HALF OF THE PICTURE

# THE LAWN

*The Culture of Turf in Park, Golfing and Home Areas*

BY

LAWRENCE S. DICKINSON

*Assistant Professor of Horticulture,*
*Massachusetts Agricultural College*

ILLUSTRATED

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# THE LAWN

## I

### THE GENERAL VIEW

To ESTABLISH the fact that good lawn turf adds to the pecuniary value of the home, estate, or golf course is often the prerequisite of a turf specialist's prescription; it seems advisable therefore that such a fact should be the first impression of this book. At your city home in the residential section you cherish the few blades of grass in the yard and nurse them to vigorous turfhood; rich uncle, at his large estate, employs skilled men to care for the turf; and the country cousin strives to get the humps out of the sod, so he can have a lawn. Each is making some special effort "to make the place look better," thus admitting the esthetic value of turf. Furthermore, there is the knowledge that with "good looks" is an increased sale price. The greenkeeper must have good turf or lose his job, and the sexton looks upon his turf very

gravely. So while living, working, or playing, and even in death, good turf means much to us. To our heirs it also means much, for they can then use the familiar phrase: "With large, well-kept lawn" when they advertise the homestead for sale.

The lawn is at least one-third of the entire picture of the house. If kept free from statuary, urns, white stone bordered flower beds, and misplaced trees, it will give freedom for vision and an impression of large area. In the flower garden and play yard the turf is the rug of the outdoor rooms.

To obtain a good turf we have what a gambler would consider à little better than even chances. Five important factors enter into the growing of good turf; these are (1) climate, (2) kinds of grasses, (3) soil, (4) seed selection, (5) time and rate of seeding. Two are uncontrollable, two controllable, and one partially so.

Turf enjoys cool, damp atmosphere, mild winters and temperate summers. Given climate that will conform to such specifications, lawn turf will thrive with "rolling and mowing." The coastal region of the states of Oregon and Washington to a depth of about fifty

miles inland is the only region in the Western Hemisphere that can boast of having ideal turf conditions with respect to climate and rainfall. The British Islands favored by the Gulf Stream, have ideal climatic conditions for turf, and are famed for their greenswards. The United States is divided into two distinct climatic regions, the line being approximately the old Mason-Dixon line from California to Virginia and then curving northward to include half of the state of Delaware. It is useless to try to make northern species of grass grow south of this line, and vice versa; and within a hundred miles of the line on either side it requires much effort to grow any turf grasses. The uncontrollable factor of climate is a very large handicap to be overcome by the turf grower in the United States.

We cannot control the fact that all of our turf grasses are foreigners, even Kentucky blue grass included. Our turf grasses like our people, come from England and the Continent. To be sure we had native grasses when Columbus arrived, but they, like our native people, could not stand close clipping, prosperity, and competition. This uncontrollable handicap is slowly being overcome, for

the United States now harvests its own Kentucky blue grass seed and red top. The bent grasses imported many years ago have now become so well established that they are found growing wild in nearly all the region above the latitude of New York City. Also, large areas are being devoted to the raising of bent grass seed in Rhode Island, Oregon and the Prince Edward Island region. These sources of North American hardy bent will, if kept pure, be of great benefit to the turf grower.

The soil is the third great factor in lawn building. It is partially controllable inasmuch as we can improve its fertility and through it administer stimulants and tonics to the grass plants. With a system of tile drains wet areas will be made drier, and the physical texture may be improved with the addition of humus, or sand as the case may be. On the other hand few can afford to change the all-important foundation soil, and no one can change the parentage of the soil; it makes considerable difference to good turf grass whether the great grandfather of the soil was a granite boulder or a limestone ledge.

The more important controllable factor in turf growing is the selection of seed. A Corot

demands a suitable frame and the best location in the art gallery, because it is worthy and valuable. One would never even think of buying a cheap frame for a sweetheart's photograph, yet in later life that same person will say, "Johnnie! go down to the corner store and get me some grass seed for the lawn." Is it right to frame the picture of a house costing ten thousand dollars with turf grown from cheap and promiscuously selected seed? It is possible to select the seed of grasses which are adapted to the soil condition of the proposed lawn, and to varied shaded and exposed locations; why not do it?

The fifth factor is also controllable. The lawn can be seeded at the proper time to permit the young grass plants to successfully compete with weeds for the supremacy of the lawn, or the seeding may be done at the time when the weeds are sure to be victors. As one can purchase grass seed in as large quantities as he desires, so can he sow it as thickly as he desires. "Whatsoever ye soweth that shall ye also reap."

Because the grading, shrubbery planting and lawn building are usually the last large operations about a new building, they in-

variably are subjected to the additional handicap of lack of funds. Unforeseen constructional costs and the fulfilment of the desire to "get things for the new house" claim all available resources. This is typical for both public and private buildings, and results in many poorly-built and seeded lawns. Would it not be a good idea to set aside, before building starts, a fund sufficiently large to assure the making of a good lawn? Experience teaches that such a fund should be placed in trust for that purpose only, otherwise it will be constantly nibbled at to satisfy some immediate desire.

A WELL-MOLDED LAWN

EVEN A SMALL LAWN, IF IT IS OPEN, ADDS GREATLY TO THE VALUE OF THE PICTURE

## II

## MOLDING THE LAWN

THE most beautiful painting is finished over a foundation, the "ground colors"; the most shapely sculptured figure is molded over a foundation, or reinforcement; the smoothest boulevard is built over a subgrade on a foundation; so, also the best lawn is made on a foundation. The picture, the statue, or the boulevard is the product of a preconceived idea of the mind of the artist or engineer, which is ever present even with the first splash of the ground color; the first rod of the statue's frame; or the first steam shovel load of the boulevard's foundation. The well molded lawn is also the result of a preconceived idea, or mental picture. If the ground color of the picture is not correct; the frame of the statue weak, or the foundation of the boulevard not stable, failure will result. If the foundation of the lawn is not considered, an acceptable turf can not be obtained. Thus the impor-

tance of having a mental picture of the finished lawn, and a knowledge of its foundation is established.

Unfortunately, not all lawn builders have the ability to picture in their minds exactly how the finished lawn will look, and therefore lose many opportunities for graceful curves and pleasing contours; yet, with the assistance of a few grade stakes and lines, the mental picture will be visible in detail and grading errors avoided. Without considering the design of the lawn (as this volume is not a treatise on landscape designing), the molding of the lawn will be discussed, beginning with the grade stakes and grade lines.

Every lawn has at least two grade points fixed: one, the street, side-walk, or curb, and the other the grade line of the house. Many lawns have additional fixed grade points, such as the base of trees, abutting property, brooks and knolls. The problem is to connect these fixed points in such a manner that the result will not only be pleasing to the eye, but also be practical. Surface water must be directed to a designated outlet, and no unsightly humps or sharp angles should be permitted. The solution of the problem is made comparatively

easy by using grade stakes and lines. The stakes should be nearly uniform in size and color, and the line should be a stout cord of one color; otherwise, the optical impressions will not be true. Ordinary white grocers' twine is very good for this purpose.

The grade stakes may be set in measured squares over the lawn area, using the building line as a base to measure from, or they may be set only along lines where the profile is most conspicuous. Important profile lines are always the continuation of all main building lines to the property edge, or to some fixed grade; the front and back walk and driveway lines; all intended valley and knoll lines and any other profiles frequently noticed. If the stakes are set on profile lines, they should be at even distances apart and additional stakes set where breaks in the grade line are to occur. If the lawn is a large area, the stakes may be at fifty foot intervals whether in squares or on profile lines, and twenty feet is a convenient interval for the small lawn. All profile lines should connect fixed grade points, and should be connected with each other by intermediate stakes.

As soon as the stakes are set, the grade lines

may be established by connecting each stake of a profile line with a string line. This line should start at a fixed grade point, such as grade line of the house, and continue to the end of the profile. The string should be taut between stakes, and should be wound about each stake at the adjudged proper grade. From a point at right angles to the line, and about fifty feet from it, carefully study the string profile. If it appears irregular, raise or lower the string on the stakes until the desired profile is obtained. When all profile lines have been made individually satisfying they should be connected by string with the other lines, and readjustments made until the whole network of string grade lines is at proper grade. As soon as the string grade marks are crayoned on each stake the string may be removed and grading operations commenced. A similar method of establishing grades is used where the grade stakes are set in squares. This method of string grade lines tests the practicability of the preconceived idea, and further fixes the picture of the new lawn in the owner's mind; it also enables one to establish grade marks on the stakes without the use of surveyor's instruments.

The time during the molding of the lawn that the grade stakes should be set is governed by the size of the lawn area, the amount of "cut and fill" to be done to obtain the desired grade, and the equipment used in performing the work. Obviously, the stakes should not be set before the lawn area is plowed; nor should they be set in places where it is known that there is to be considerable cutting or filling; neither should they be set at a time when they will unduly hinder the operations of tractor or horse-drawn graders.

With a clear idea of the finished lawn in the mind, the next step is to make the lawn area conform to the idea. Before enumerating the various steps for the physical molding of the lawn it is best to consider some of the requirements of grasses. Lawn grasses require a moderate amount of food, and a large quantity of water. Both are equally important, and for best results should be supplied in small quantities continuously throughout the growing season. To accomplish this is not difficult if the lawn is properly molded.

The soil must be considered in three parts: (1) The topsoil or loam; (2) the subsoil; and (3) the foundation, that which is below the

subsoil. From the topsoil the grass obtains its food, from the subsoil its water supply, and the effectiveness of both is controlled by the foundation.

Specifications for the construction of a lawn that were written twenty-five years ago, would insist upon a top layer of loam at least twelve and more likely eighteen inches thick. Lawns that were molded twenty-five years ago with such a depth of loam, and have been correctly fertilized since that time, are growing luxuriently today, and prove the theory to be sound. Today a topsoil of eighteen inches, or even twelve inches of loam, would make the cost prohibitive, and we are molding successful lawns with only four or five inches of loam or topsoil. Grass roots seldom go below five inches, and very often we find Bent grasses sending their roots down only two inches. Bearing the depth of root systems in mind, it is obvious that five inches of loam, or feeding depth, is sufficient.

Growing grass contains from sixty-five to seventy-five percent water by weight; add to that amount the amount lost by transpiration, and in clippings; the answer is the water requirement of grass. To that total, add the

amount of water that is evaporated into the air through the soil and that lost by percolation; the answer is the amount of water that the subsoil must supply. It is the function of the subsoil to collect, retain and return by capillarity to the grass roots a sufficient amount of water to keep the roots constantly and adequately supplied at all times. This subsoil need not have any food value, but must be sufficiently deep to function properly. The proper depth is determined by the physical characteristics of the foundation. Over gravel twelve inches of subsoil is needed; over clay, six to eight inches; and over sand, ten inches.

With the picture and requirements well in mind it is a comparatively easy matter to manipulate the soil and get the desired results. The entire lawn area should first be plowed, the loam scraped and piled from all places where there is to be a cut of four inches or more; and a fill of six inches or more. The change of grade must be made in the subsoil or foundation, otherwise parts of the lawn will be greener, and healthier than others because of the excess moisture they obtain from greater depth of soil, or brown spots will ap-

pear where there is too thin a subsoil and topsoil over a leaching foundation. If the lawn is built over a sand foundation it will pay to scrape off the loam, remove four to six inches of the sand and replace it with hard coal ashes. These form a very satisfactory subsoil because of their water retaining properties. The loam, of course, would be put over the ashes. If rock out-croppings appear, they should be capped with clay loam for a subsoil. The subsoil, like the artificial foundation of a boulevard, should vary in depth according to the natural foundation that it rests upon; thus assuring uniformity in the visible surface. The topsoil should, as far as possible be even in depth, five inches or more over the entire lawn area. The eighteen inch deep topsoil of long ago furnished both food and water.

Tin cans, bottles, brush or rags make mighty poor filling for a lawn, also does building debris. A plank covered one foot or more will be outlined in the grass during dry periods, and of course no one would consider permitting plasterers refuse to be covered in grading the lawn.

The subsoil and foundation, if it is neces-

sary to disturb them, should be brought to grade lines exactly parallel with the finished grade, and at the correct distance below. All stones the size of a hen's egg or larger should be picked up, and both foundation and subsoil thoroughly compacted by tramping, rolling or working over with men and machinery, before any loam is spread. For best results the loam should be spread with drag scrapers, or by hand from carts or dumping boards. Otherwise, serious depressions will appear in the lawn which will be entirely due to unevenness in settling, and the loam surface should be about two inches above the grade line to allow for settling.

The picture thus far is well established in the mind, and the foundation, or ground color, "on the canvas." The picture will soon develop with figures, visible to the untrained artist. So in succeeding chapters will the lawn be developed into a completed picture.

## III

### PREPARATION OF THE SEED BED

THE seed bed of a lawn is really the top soil or loam, and like any good bed it has three layers: (1) the top inch, or bed clothes; (2) the next two inches in depth, or mattress; and (3) the remaining depth, or bed spring; all of which are essential to the comfort and health of the occupant. These layers are particularly important to grass plants, because not only do they act as a seed bed, but they must nourish the young grass plant through its youth, and then maintain it through the vigor of life and dotage 'til death. Therefore the seed bed should be of such texture as to permit easy development of a root system, and contain a quantity of the chemical elements necessary for plant life. It should also contain at least twenty-five percent of voids or air spaces; plenty of moisture and yet not be wet, and be prepared for occupancy in either the spring or fall seasons.

To meet the requirement for the physical properties of an ideal topsoil; one must have a loam reasonably rich in organic matter or humus and containing from 15 to 20 percent of clay, 45 to 50 percent of silt and the remainder sand. Such a topsoil is not difficult to obtain if properly managed, although one usually has to start with a topsoil that will fall under one of the following classifications: sandy, sandy loam, clay loam, or clay.

The doctrine that good construction makes for low cost of maintenance is particularly adapted at this point in the building of a lawn. Too often home owners, and particularly contractors and real estate agents, in their haste to get "a lawn" saddle themselves, or their customers with a lawn area that will give chronic trouble, or require an expensive operation because of poor construction. For many reasons it is not wise to permanently plant a lawn as soon as the "new house is finished" or grading completed, even though it should be properly molded. Workmen planting the shrubbery, and doing the many "last things" about the new house will leave permanent memorials, in the form of worn and excessively packed spots all over "the new lawn."

Furthermore in one season poor soils can be made much better, and unevenness smoothed, so that a truly permanent lawn can be planted.

Many subdivisions are being made on land that is either very sandy or very clayey. On such topsoils no attempt should be made to plant a lawn until the area has been cover cropped. Cover cropping means to grow a crop for the purpose of plowing it in before maturity, thereby improving the soil both as to texture and food content. As before intimated, cover cropping is very beneficial to both sandy and clay soils, even Cape Cod sand has been made to produce good turf after two seasons of cover cropping.

It surely is a great temptation, when one moves into a newly built house May 1, to immediately "plant a lawn." Yield not! Grow cover crops and plant in the fall. If the lawn is molded and ready for seeding in the spring it should be cover cropped with rye or oats sown thickly. This crop should be shallow-plowed in the latter part of June, and the area seeded to buckwheat at the rate of three pecks per acre. The buckwheat should be plowed in while the stalks are green and succulent (about September 1 for the Northern latitudes) and

the ground permitted to remain fallow for about two weeks. It should then be prepared for seeding. If the area is not ready until midsummer, grow only one cover crop, and if it should be fall before any work could be done on the lawn area, sow winter rye to plow in early spring to be followed by two more cover crops. If the soil contains over twenty-five percent clay, one application of lime at the rate of fifty pounds per one thousand square feet of surface will be of great benefit. On soils capable of growing a fair vegetable garden cover cropping need not be practiced, but it is very necessary on sandy or clay soils. In all cases the seed bed should be fully prepared in the fall, if possible in time for fall seeding and if not for spring seeding on the "honey comb," when the top is thawing and freezing.

All soils are improved by the addition of manures, and often they can be substituted for cover crops. The only factor against the use of manures is their unknown weed seed content. However, this liability need not be very serious if the manure is applied several weeks before seeding time, for a great majority of the weed seeds will have germinated and the young plants will be destroyed in the final

preparation of the seed bed. It is far better to harrow the manure into a lawn surface than to plow it in.

In preparing the real seed bed (bed covers) the molded lawn should be thoroughly harrowed or shallow spaded. Grade strings should then be restrung and the entire area raked with iron rakes. This raking should not only remove stones and debris, but should smooth out any unevenness and round off all sharp corners caused by abrupt bending of the grade lines. The raker should be cautioned to do as much "pushing" as "pulling" with his rake, otherwise there will be an excessive accumulation of loam at the lower part of the area. Experience teaches (though it is seldom practiced) that it is better to rake up the slope than down it, for the same reason. As soon as this raking is completed and the area appears ready for the seed, roll the area with a medium heavy roller. Unexpected hollows and hills will appear, lumps of earth will be crushed and the temptation to seed after the first raking is alleviated by the obvious necessity for another raking. This raking, the final one, should be done with a wooden lawn rake. It should effectually smooth the surface and

loosen the soil to a depth of at least three-quarters of an inch, leaving a soft, open, clean and thoroughly pulverized seed bed.

If one desires to use a pre-seeding fertilizer other than the manures, super-phosphate at the rate of sixteen pounds per one thousand square feet will be found to be very helpful to the young grass plant. This should be incorporated into the soil with the first raking.

## IV

## SEED SELECTION AND PLANTING

THE artist who has been very particular with his "ground colors" may become careless in the development of the figures and details of his picture; the automobile manufacturer might place a perfect and powerful engine on a weakly-constructed chassis; or the home owner sometimes seeds his well-molded lawn with "Tim's Tufty Turf" mixture, bought at a bargain sale. In each instance failure to realize the best results is sure to follow. The artist and manufacturer are personally held responsible, but the home owner goes "scot free" while the soil gets the indictment; yet the three individuals are equally guilty.

As with all commodities, the price and quality of lawn grass seed is governed by what the public will pay and demand. Common knowledge concerning a commodity is the governing factor for quality demanded; and until the

landscape architect, landscape contractor, park, estate, and golf course superintendent, together with the home owner becomes better acquainted with grasses and grass seed, "Tim's Tufty Turf" lawn grass mixture will be the "best seller."

Grass seed can now be cleaned and selected to guarantee a high percentage of purity and germination. The price the consumer is required to pay for such a mixture appears excessive on first thought, and a lower-priced but much inferior grade of seed is very likely purchased. Many states have seed laws which require each seed package to have a label that tells the names of all grasses appearing in excess of five percent by weight, the percent of inert matter, other commercial seeds, and weed seeds. In addition the label must have the name of the vender and the name of the brand.

Such a label should tell the truth, and if one purchases a package thus marked, he alone is responsible for the result. The data on such a label is of little value, however, if it is not correctly interpreted by both the salesman and the consumer.

The grass seeds usually found in lawn mix-

SAMPLE LABEL

COMMON NAME .....
PURITY .....PER CENT
WEED SEEDS .....PER CENT
Inert Matter .....Per Cent
Other Crop Seeds Present .....Per Cent
NOXIOUS WEEDS .....
.....SEEDS PER OUNCE
GERMINATION .....PER CENT
Percentage of Hard Seeds.....
DATE TESTED: Month.....Year 193...
NAME .....
ADDRESS .....

tures sold in the Northern States are divided into four groups:

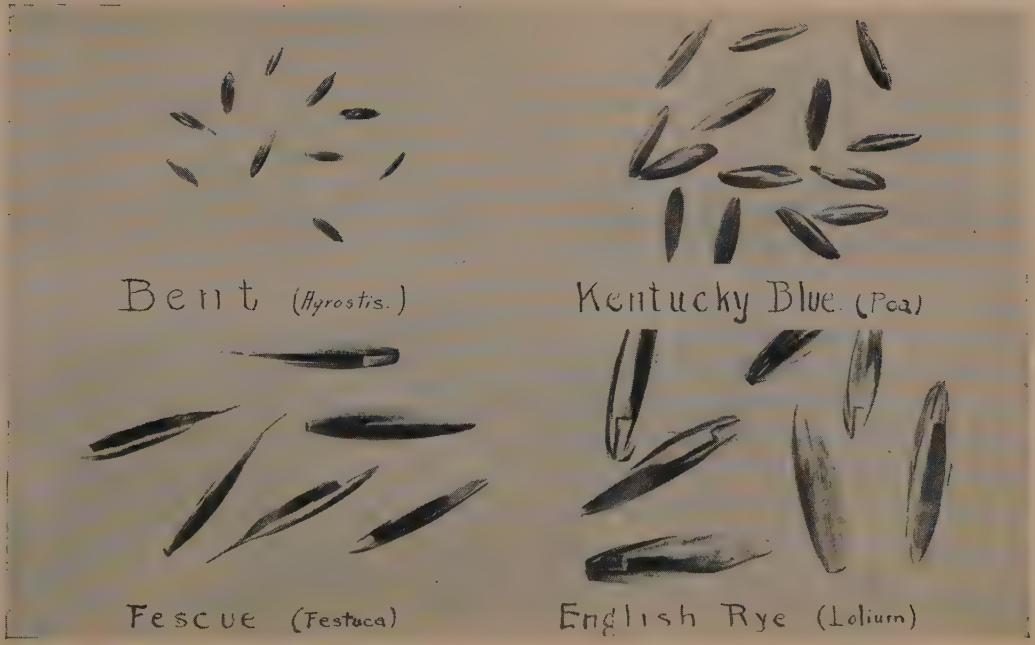
A. Basic Grasses—Those which, because of soil environment, will predominate as the lawn ages.

B. Nurse Grasses — Quick-germinating grasses which are to act as the "shock troops" against the weeds. They must germinate quickly, grow rapidly, and die as soon as the basic grass requires their space.

C. Filler Grasses—Grasses not adapted to lawn purposes, but used to increase the bulk of the package or lower the cost per pound.

D. Special Purpose Grasses—Grasses

THESE SAMPLES WERE OF EQUAL WEIGHT. NOTE CHAFF, WEED SEEDS AND INERT MATTER IN "CHEAP" MIXTURE




ALL BENT SEEDS ARE VERY SMALL. ALL BLUE GRASS SEEDS ARE SMALL. ALL FESCUE SEEDS ARE LARGE. ALL RYE GRASS SEEDS ARE VERY LARGE

Other seeds appearing in a mixture are undesirable except in very special cases

adapted to peculiar locations such as shade, sand, or terraces.

TABLE I—SHOWING GRASSES COMMONLY FOUND IN NORTHERN LAWN MIXTURES AND GROUP TO WHICH THEY BELONG.

| *Species* | *Group* |
|---|---|
| Canada blue grass. *Poa compressa* | D |
| Chewings fescue. *Festuca rubra* var. *fallax* | A |
| Colonial bent. *Agrostis tenuis A. vulgaris* | A |
| Crested dog's-tail. *Cynosurus crestatus* | C |
| Domestic Rye. *Lolium species* | B |
| English blue grass. *Festuca pratensis* | C |
| English Rye grass. *Lolium perenne* | B |
| Fine leaved fescue. *Festuca capillata* | D |
| German bent. *Agrostis species* | A |
| Hard fescue. *Festuca duriuscula* | C |
| Italian Rye grass. *Lolium multifolium* | B |
| Kentucky blue grass. *Poa pratensis* | A |
| Meadow fescue. *Festuca pratensis* | C |
| Orchard grass. *Dactylis glomerata* | C |
| Pacey's rye. *Lolium perenne* | B |
| Red fesque. *Festuca rubra* var. *genuina* | A |
| Red top. *Agrostis palustris; A. alba* | B |
| Rhode Island bent. *Agrostis tenuis A. vulgaris* | A |
| Rough stalked meadow grass. *Poa trivialis* | D |
| Seaside bent. *Agrostis maritima* | D |
| Sheep's fescue. *Festuca ovina* | C |
| Timothy. *Phleum pratensis* | C |
| White clover. *Trifolium repens* | C |
| Wood meadow. *Poa nemoralis* | D |

TABLE II—FOR NORTHERN GRASSES.

| *Basic species* | *Soil Preference* | *Acid or alkaline preference* |
|---|---|---|
| Bents | Heavy loam to clay, moist | Acid |
| Blue grasses | Rich loam, good garden soil | Alkaline |
| Fescues | Light loam to sandy loam | Neutral to acid |

The soil preference of nurse grasses need not be considered.

The filler grass seeds and special purpose grass seeds in a mixture will undoubtedly germinate and grow very green and healthy young grass plants; but these plants, being not real lawn grasses or in unfavorable locations, soon die and leave spaces for weed growth. Also, a basic grass preferring an acid soil will succumb to weed competition if grown on a soil kept alkaline.

It is better to purchase pure varieties and do the mixing at home than to rely upon a standard package lawn seed, particularly if the area to be seeded is large.

All parts by weight and the seeding rate 3½ pounds per 1,000 square feet of lawn surface. A thick seeding is essential, but more

TABLE III—VARIETIES TO BE USED WHEN MIXED AT HOME.

1. Good Soil—known to be acid—Rhode Island or South German bent 4 parts, Red top 1 part.
   Good soil—known to be alkaline—Kentucky blue grass 6 parts, Red top 2 parts.
   Good soil—unknown as to soil reaction—Kentucky blue grass 6 parts, Rhode Island or South German bent 4 parts, Red top 1 part.
2. Sandy soil—Rhode Island bent 2 parts, Chewings fescue 5 parts.
3. Shady location—Fine-leaved fescue 1 part, Rough stalked meadow grass 1 part.

than 5 pounds per 1,000 square feet is too thick for healthy sod.

Seed of individual varieties are listed with both purity and germination guarantee. Example: Kentucky blue grass 90%–85%. The percentages are interpreted to mean that the bulk contains 90% pure seed with a guaranteed germination of 85%. Many seed houses list one variety in three grades and prices. Usually the best grade is really the cheapest to purchase.

From Table IV it is obvious that one should not pay more than 60% of the price asked for 90%–90% seed when purchasing 70%–

TABLE IV—COMPARISON OF SEED VALUES BASED UPON 1 POUND 90%—90% SEED AT $1 PER POUND.

| Seed analysis... | 90%–90% | 80%–80% | 70%–70% |
|---|---|---|---|
| Weight of viable seed ..... | .81 lbs. | .64 lbs. | .49 lbs. |
| Amount to sow per 1,000 sq. feet ..... | 3 lbs. | 3.79 lbs. | 5 lbs. |
| Price per pound to be equal in value ..... | $1.00 | $.79 | $.60 |

70% seed. Also, that it is necessary to purchase 66% more seed of the lowest grade seed to obtain the same number of viable seed as in the higher grade.

Commercial lawn seed mixtures will not conform to those suggested in Table III, but they should not contain any filler grass seeds, preferably no special purpose grass seeds, and only one nurse grass. However, it is permissible for them to have two basic grasses, one preferring acid soil and one preferring alkaline soil.

Prepared seed mixtures for various locations such as terraces, seaside lots, tennis courts, and dry knolls may be obtained. If

these are purchased from respectable seed houses, the results are likely to be satisfactory.

As the fescues and bent grasses are indigenous to the Rocky Mountains, all lawn grass mixtures used in the Rocky Mountain states

TABLE V—FOR SOUTHERN GRASSES

| *Species* | *Soil Preference* | *Acid or alkaline preference* |
|---|---|---|
| Bermuda grass | Heavy, sandy loam | Acid |
| Centipede grass | Loose sandy soil | Alkaline |
| Buffalo grass | Arid, unfertile soil | Alkaline |
| Carpet grass | Low, rich loam | Acid |
| Grama grass | Arid, unfertile soil | Alkaline |
| Manila grass | Sandy loam | Neutral |
| St. Augustine grass | Seashore | Alkaline |

should contain Red or Chewings fescue and Rhode Island, Colonial, or German bent in equal portions with a small amount of Red top as a nurse grass.

On the Pacific coast rye grasses and various strains of *Agrostis maritima* appear to be the most satisfactory turf grasses.

Having obtained the seed, the sowing is very simple. If the area is very large, the

wheelbarrow mechanical distributor is the best implement to use. The distributor operates like a wheelbarrow and sows a strip from 14 to 16 feet wide. Hand seeding is not difficult for the amateur if he will divide the quantity of seed to be used into four equal parts. With each part cover the entire area, for example, going east and west; then north and south; then along each of the two diagonals. By seeding this way an even distribution of seed will be secured.

Of course there must be no wind blowing when one seeds the lawn, and if a slight air current does appear sow only with the wind even though the walk back is idle. Unless this is done thin strips will be noticed after the grass comes up. This is due to the fact that much seed will be blown back onto the sower, and remain on his clothes.

As soon as the seed has been sown, it should be carefully raked into the soil. A wooden lawn rake is very suitable for such a purpose, and the operator must not let the rake bear its full weight upon the soil. The object of the raking is to spread a very shallow covering of loam over the seed. Raking should not continue until all seeds are covered, but not more

than thirty-five percent of the seed should remain uncovered.

Immediately after raking, the lawn should be rolled with a medium heavy roller. This rolling is very essential as it presses the seed into the soil, and hastens the rise of soil water by capillarity. Immediate rolling also prevents excessive loss of seed by blowing away, and smooths the surface of the lawn area. Rolling will advance seed germination from 36 to 48 hours and noticeably increase the rapidity of growth in the young grass plant.

Unless the weather appears to be "in a dry spell" and the soil is very dry, sprinkling the new seeding is of very questionable value. If it is done, the sprinkler must deliver the water as a fine spray and not as a pelting rain. If a rain storm is in the offing at the time of seeding, excessive washing of the lawn surface may sometimes be prevented by sprinkling it.

When sowing "shady spot" seed never sow to a line about the shaded area, but scatter "shady spot" seed a few feet into the open lawn and some of the regular lawn seed into the shade. By doing this the line of demarcation between the two areas will be avoided and the different textures will be blended to-

gether. This suggestion also applies to the seeding of terraces.

Should there be seed left over, it should be stored in a cool dry place, as heat will devitalize the seed very rapidly.

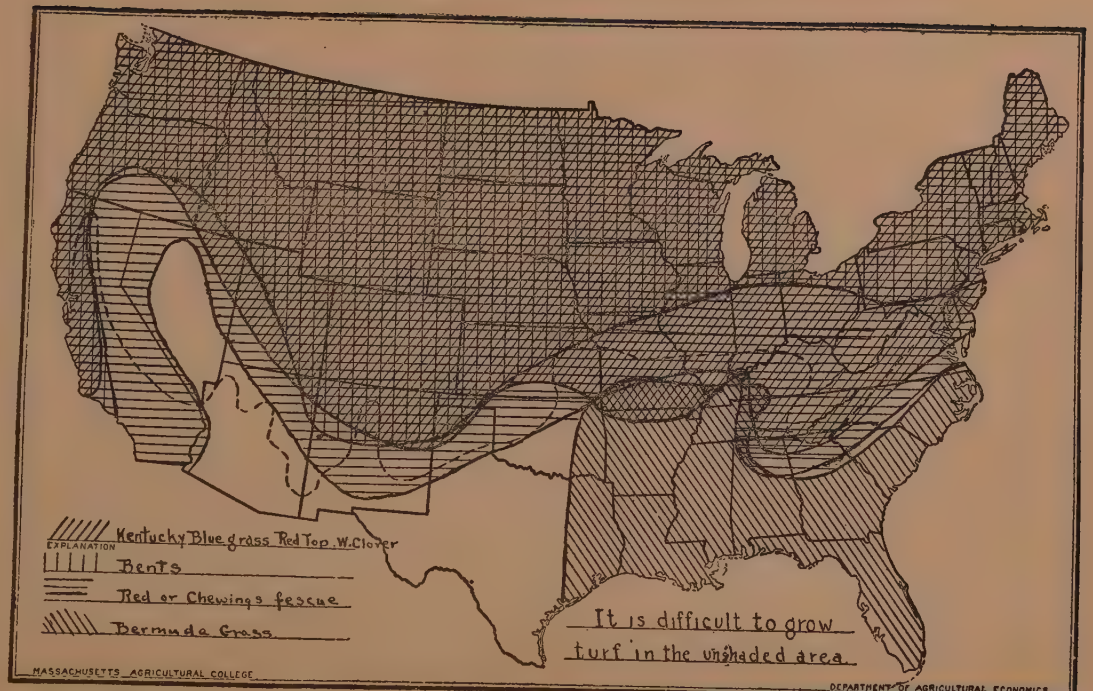
## V

## IMPORTANT TURF PLANTS

"Grass is the forgiveness of Nature—her constant Benediction." (Ingalls.) To be certain that the Benediction is universal in scope and is present in fair or foul weather Nature has produced over thirty thousand species of grasses. Yet from this number it is difficult to name thirty species that are suitable for intensive turf growing as it is now practiced.

To be sure, some of these species, (notably Bent) have a number of strains of more or less merit, which are sold as strains, or in some instances as a supposedly new species, using the strain name as a trade name. Certainly for lawn purposes "special strains" should be avoided and selection be made by species only, and in no case should a species be selected that is not adapted to the region where it is to be used.

To describe in detail the various lawn grasses would require a large volume, so this


EXPLANATION
Kentucky Blue grass Red Top W. Clover
Bents
Red or Chewings fescue
Bermuda Grass
It is difficult to grow turf in the unshaded area.
MASSACHUSETTS AGRICULTURAL COLLEGE
DEPARTMENT OF AGRICULTURAL ECONOMICS

MAP SHOWING REGIONAL RANGE OF ADAPTABILITY OF VARIOUS TURF SPECIES

chapter will attempt to give only such information that will be of value to the home builder, particularly if it is combined with the facts obtained from the other chapters.

## THE BENTS—(*Agrostis* SPECIES)

The Bents (except Red top) will grow thick turf on any *acid* soil unless it be very sandy or shady. They prefer a moist soil, yet some species are drought-resistant. The Bents, except Red top, are low growing, dark green in color, long-lived and very hardy, and their turf is ideal for the lawn, fairway or putting-green. The leaf is rolled in the bud and tapering to a sharp point.

1. Red top (*Agrostis alba, A. palustris*)—Is a valuable servant which should be sown with nearly all lawn grass seed, and should be considered as a nurse crop only. It does not stand close clipping, becoming coarse and stubbly and seldom remains in a lawn more than a year and a half. The seeds are found with all bent seeds, and if in sufficient quantity to lessen their value, will impart a brilliant silvery and lavender color to the sample. Red top should never be sown alone for a lawn.

2. Rhode Island Bent (*A. tenuis, A. vulgaris*)—Imported from England before 1790 it has proven its adaptability by naturalizing so thoroughly that it is found growing wild all over the northern half of the United States and in southern Canada. A strain called Colonial bent or Brown top is obtained from New Zealand and its turf compares very favorably with that of true Rhode Island bent. Limited quantities of seed are obtained from Rhode Island, Washington state, and from Prince Edward Island. True *A. tenius* does not produce stolons, but large individual plants which crowd together, producing a firm but somewhat open turf. It is considered excellent for seaside lawns and is very resistant to drouth. Rhode Island bent is undoubtedly the most practical seed to use in the northern United States.

3. Velvet Bent. (*A. canina*)—Pure velvet bent seed is very difficult and expensive to purchase. For the home builder the seed is obtained in German bent seed only. This grass is often seen in old lawns as dense, dark green circular patches with a velvety texture. Velvet bent greens are what nearly every greenkeeper is striving to obtain.

4. German Bent. (*A. stolonifera* varieties) —A mixed bent seed obtained from Germany and sold as German bent, or South German Creeping bent. Until Rhode Island bent seed is more easily obtained this is probably the best seed for the home owner to buy. Typical South German bent seed contains Rhode Island bent 40%–60%, velvet bent 10%–30%, Red top 10%–30% and true Creeping bent 15%–30%. Because of the various grasses in the mixture the resulting lawn will be somewhat mottled. There will be spots of very fine leaved bright colored grass, the Velvet bent; irregular patches of blue green mats, the Creeping bent; and between these patches will be dark green grass, the Rhode Island bent. The whole will be pleasing and the turf excellent.

5. Seaside Bent. (*A. maritima*) Fiorin grass—True seaside bent will withstand salt sprays and an occasional high tide. Seed under a trade name is grown in Oregon, and the grass may be propagated easily from stolons, of which there are many strains growing wild along the Atlantic seaboard. It is of doubtful value as an inland turf.

6. Creeping Bent. (*A. stolonifera*)—There

are many strains of this species all of which are propagated from stolons, as no pure seed is obtainable. It makes a thick mat-like turf which is very desirable.

All the Bents are slow starting in the spring, but as they do not mature until late summer they retain their color very late in the fall. The seeds are the smallest of the lawn grass seeds (8,000,000 per pound,) and produce the finest textured turf. Purity ranges from 70% to 90% and viability from new crop seed from 80% to 90%.

### The Blue Grasses (*Poa* Species)

The blue grasses all prefer an alkaline soil, and are slow to germinate, thus requiring a nurse grass. Their soil preference and early maturing season (July) make their competition with weeds very difficult. The leaf characteristics of the blue grasses are the blunt boat-shaped tip, and the fact that the leaves are folded in the bud.

1. Kentucky Blue Grass (*P. pratensis*)—The best grass to use on fairly rich, well-drained soil having an alkaline reaction. It should never be used alone as it is very slow

in germinating and because the young plants are not aggressive, the turf is never fully developed until the end of the second year from planting. Under high shade and on northern exposures this grass is particularly well adapted; but it is seriously affected by the heat. Under favorable conditions it will spread by short underground stems, and will crowd out competing grasses. It is particularly desirable to sow this grass in the fall, and if possible with year-old seed, as new crop seed often is low in viability. The seed is market graded by weight, 14 pounds to the bushel being the United States standard. Market weights vary from 14 pounds to 28 pounds to the bushel. Experience teaches that 24 pounds to 26 pounds seed is the most economical seed to purchase.

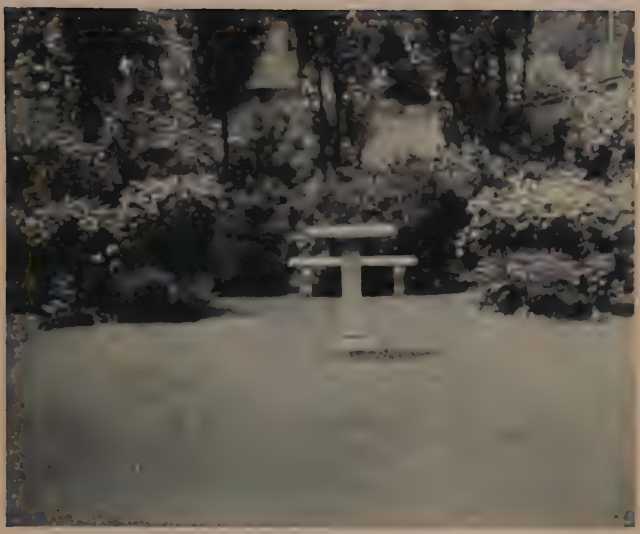
2. Canada Blue Grass (*P. compressa*)—Distinguished from Kentucky blue by its compressed stems, blue green color of the blade, and its prominent root stocks. Its use is confined to very poor clay soils and gravel knolls, or as a soil binder on silt. Because this grass keeps its color better it is often mixed with Kentucky blue grass by seedsmen. It should, however, be considered as an undesirable adul-

terant. Mixed with Chewings fescue it makes a fair turf.

3. Rough Stalked Meadow Grass, or Bird Grass (*P. trivialis*)—Leaves bright yellow green and very glabrous. Stems low growing and very creeping, resembling Creeping bent. Enjoys damp and shady locations, where it produces a good turf. In the open lawn, it is injured by the heat but seldom completely killed. Its presence in a lawn mixture is not undesirable; in fact, the grass is yearly becoming more popular. This grass responds particularly well to fertiliztaion with nitrate of soda.

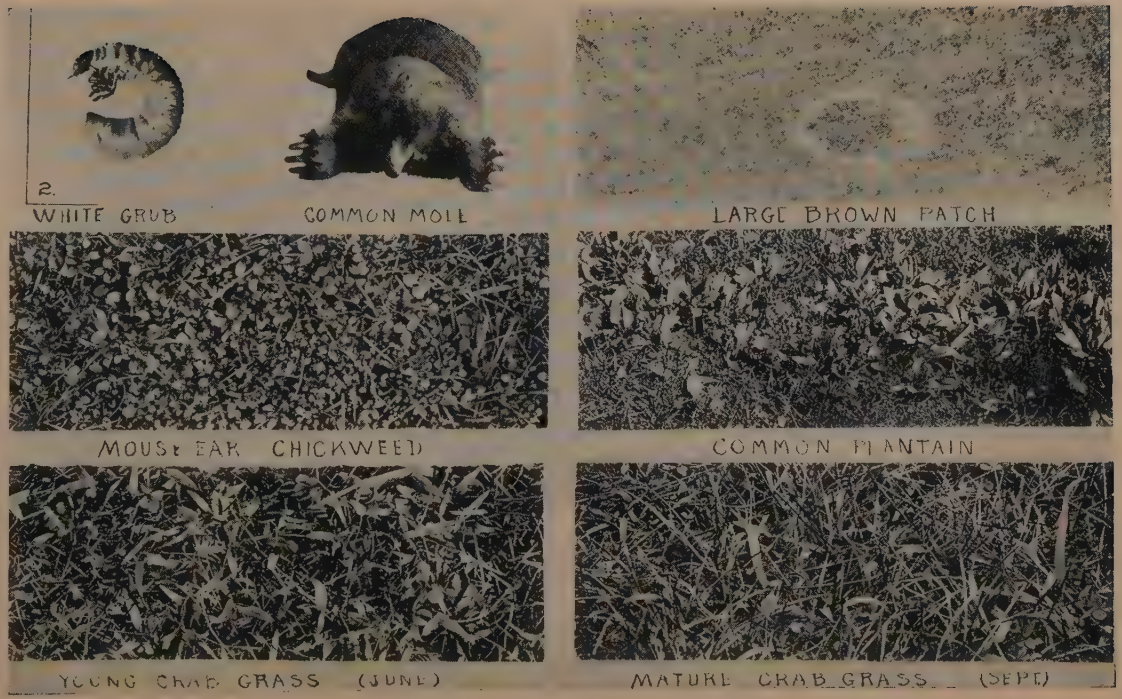
4. Wood Meadow (*P. nemoralis*)—A flat low-growing non-creeping grass, very dark in color and of medium texture. Some agrostologists feel that it will not live in America. Its particular use is in mixtures for dry shady locations. It should never be used alone.

The seed of the blue grasses is small, averaging about 2,400,000 in a pound. The texture is medium. The leaves are distinguished, with the exception of *Poa trivialis*, by their upright growth. Seed purity runs from 70% to 90% and germination tests from 70% to 85%.



*Above*—A lawn from selected seed, correctly sown on an acid soil

*Below*—A lawn from "Tim's Tufty Turf" seed mixture sown on an alkaline soil




A FEW COMMON LAWN PESTS

## The Fescues (*Festúca* Species)

The Fescues are not particular as to their soil reaction except Red Fescue which appears a little more satisfied on acid soil than alkaline. They all have fine leaves that are round and bristle-like, and are very low-growing and bunchy. They thrive best on poor sandy soils and if properly used will give the desired results.

1. Sheep's Fescue (*F. ovina*)—Leaves blue green and very bristly, producing stools or tussocks from four to eight inches in diameter. The seed often occurs in low-priced mixtures and poor grade Red fescue. There is no place for this grass in a lawn, but it does make an excellent rough on the golf course.

2. Hard Fescue (*F. duriuscula*)—Very similar in habit to Sheep's fescue except the tussocks are larger and higher. The seed is found in poor mixtures.

3. Various Leaved Fescue (*F. heterophylla*)—Will give a very fair but bunchy turf if used under shade on soil rich in humus. The color is very dark green.

4. Fine-leaved Fescue (*F. capillata*)—A

most beautiful dark green grass, with fine short leaves whose texture is less wire-like than any of the other fescues. Probably the best dense shade grass there is. Tufts are seldom more than two inches in diameter. It blends well with *Poa trivialis*.

5. Red Fescue (*F. rubra*)—The only fescue adapted to lawns. It is a rapid spreader and one plant will often grow to six feet in diameter. Leaves dark green with reddish base and persistent after death. On sandy loam if seeded alone it will produce thick, drouth-withstanding turf practically free from weeds. The texture is wire-like and the turf somewhat difficult to mow. Red fescue prefers acid reacting fertilizers, and the seed is of very uncertain viability. True European Red fescue, (F. *rubra var. genuina*) if pure, is the best strain to use. Chewings fescue, (*F. rubra var. fallax*) comes from New Zealand grown seed, which must be new-crop seed to obtain any reasonable percentage of germination. This seed, however, is very pure, and is to be preferred to European fescue unless the latter is of high test.

6. Meadow Fescue (*F. pratensis*) sometimes called English blue grass—A very bright

green fescue with flat coarse leaves. It is adapted to wet soil where it makes a very rank growth. Under close clipping it becomes coarse and open in texture, and will not make a continuous turf. It is really a filler grass in a seed mixture for lawns.

The mission of the Fescues is variable; red alone is a basic grass, all others for special locations or uses, and none really desirable. The seeds are large (600,000 seeds in a pound), are free from weed seeds, but are very likely to be mixed. The vitality of the seeds is of very short duration and only new-crop seed should be used.

## The Ryes (*Lolium* Species)

Rye grasses are quick germinating and fast growing grasses that are used as cover crops or nurse crops. Their broad, glossy leaf is their distinguishing characteristic.

1. Perennial Rye (*L. perenne*) English rye —The seed is distinguished from Italian rye by the absence of the awn. Seedlings of rye grass will grow nearly three times as fast as those of any of the lawn grasses, and perennial rye will remain in a lawn for nearly two years.

It is therefore particularly adapted as a nurse for Kentucky blue grass and for spring seedings. Paceys' English Rye is a short-seeded and improved strain of English Rye.

2. Italian Rye (*L. multifolium*)—An annual or short-lived perennial very similar to English Rye. The seed has a very long awn. It can be used best as a nurse with bents or early fall seedings and as a winter substitute for Bermuda grass in the cooler regions of the South.

3. Domestic Rye is an American grown perennial rye, whose life in turf is only one year, or possibly two growing seasons.

Ryes have very large seed (220,000 seed in a pound) which often contain many weed seeds unless the very best grade of seed is obtained.

### Other Northern Grasses

1. Timothy (*Phleum pratensis*)—A hay grass too coarse for a lawn; should not be in any mixture.

2. Orchard grass (*Dactylys glomerata*)—A filler grass of no value in a lawn.

3. Crested Dog's-tail (*Cynosurus crestatus*)

—Except in New England and the coastal regions of Washington and Oregon this grass will not thrive in North America. Just another filler grass.

## Southern Grasses

1. Bermuda grass (*Cynodon dactylon*)—The creeping bent of the south, producing a quick and dense turf from rapidly creeping above-ground runners. It is propagated by seed or stolons, and can be obtained in many strains of which Atlanta is the best.

2. Centipede grass (*Eremochloa ophiuroides.*)

3. Blue couch grass (*Digitoria didactylos.*)

4. Manila grass (*Osterdamia matrella.*)

All are Southern lawn grasses which are creepers and can be propagated vegetatively better than from seed.

## Clovers

While clovers are not lawn grasses they do appear in lawn grass mixtures and must be considered although they are hardly more than weeds.

1. White Dutch Clover (*Trifolium repens*)—Low growing clover with white blossoms on short stems. Spreads rapidly by runners and completely domineers in its locality. Always volunteers in alkaline soils and has as its single excuse for being in a lawn the fact that it is "green in dry weather." It will disappear from a lawn in a very short time without any apparent cause, and leave a bare and starved spot. The leaf makes an entirely different texture than the grass leaf; in fact a clover spot is comparable to an ink spot on a neatly written essay.

2. Japan Clover (*Lespediza striata*)—A very rapid-growing southern annual. If sown with Bermuda grass it will make an excellent turf until the grass is established.

## VI

## PLANTING A LAWN WITH STOLONS

A STOLON is a creeping stem which has a number of joints, or nodes, from which new shoots and roots are developed, each shoot being able to produce an independent plant. The closeness of the nodes determines the texture of the resultant turf and usually indicates the rapidity with which the plant will spread.

The planting of a lawn with stolons is called planting by the vegetative method, as there are no seeds used, propagation being entirely by nodes and roots. All of the basic grasses of the South propagate very readily from stolons, while the only northern grasses that can be successfully grown this way are Creeping bent, Velvet bent, and Seaside bent.

Because all the characteristics of the parent plant are reproduced in the node-developed offspring, many strains of each species have been segregated. Washington, Metropolitan, Columbia and Vermont are the best known

of the Creeping bent strains, and Atlanta of the Bermuda grass. From these strains there have been developed by selection many strains sold under trade names. Velvet bent stolons are not found on the market and the few strains of Seaside bent are found only in very limited quantities. Often excellent strains of the northern grasses may be found growing wild in pastures, meadows, and along the seashore, and it is from this source that the home owners will probably get their Velvet bent and Seaside bent stock.

The price of stolons for a lawn is about four times the price of seed for the same area, but this cost can be greatly reduced if the home owner raises his own stock. The home turf nursery requires very little effort and expense and produces fresh, hardy stolons for planting, and the thrill of having "raised the stock myself."

Nurseries may be started in the spring or fall in a corner or along the edge of the garden. The room required is easily estimated when the square area of the projected lawn is known, for one square foot of turf stock will make about 125 feet of nursery row, which in a season should produce 250 square

feet of turf, which in turn will plant 2,500 square feet of lawn area. The nursery rows should not be less than two feet apart and there should be at least one foot margin along the outer rows.

The method is very simple. The turf stock should be shaken (not washed) free from earth, pulled into short runners and these runners planted about four inches apart in a shallow trench. The runner should be partly covered with earth and pressed firmly with the foot or back of the hoe. The nursery will need an occasional weeding and cultivating, and watering in the very dry periods. Early spring-planted nurseries should be used for fall planting and a fall-planted nursery will give stolons for summer planting. Nursery stock which has produced seed or become coarse is unfit for lawn use.

The preparation of the stolon bed, when a lawn is to be planted by this method, is the same as the preparation of the seed bed, and need not be discussed in detail in this chapter. Just previous to planting, the lawn area should be raked, but need not be left in as smooth condition as for seeding; in fact the ridges

formed by the rake teeth make an excellent planting surface.

If the stock is taken from the home nursery, it should be carefully measured so that one square foot of nursery turf will be planted upon ten square feet of lawn area. Only a few feet of turf should be lifted at a time, the earth shaken from the roots, the turf pulled apart, and then either run through an old-fashioned revolving feed cutter or laid upon a plank and cut with an axe or heavy carving knife, into pieces one inch to one and one-half inches long. Stock from a commercial nursery comes in bags already chopped and may be planted at once, or stored in a cool dry place.

The chopped stolons should be dropped evenly over the measured area, and immediately covered with sifted loam, also dropped, as spreading the loam with a shovel will push the stolons into rows and result in an uneven planting and covering. The loam top-dressing is for the purpose of holding the stolons in place and to help keep them from drying out. A quarter of an inch is ample, and best results will be obtained if a part of the stolons are left uncovered.

Following the covering, the stolons should be rolled and sprinkled in such a manner that there is no washing of the top-dressing. Should washing occur the washed areas should be re-top-dressed. It is not necessary to water the stolons every day after planting but a light sprinkling twice a week for the first four weeks will be well worth the effort.

Two days after planting, young shoots will appear, and at the end of a week the area will have the appearance of a very thin lawn. Many weeds will have started by this time, but experience teaches that these weeds need not cause any worry for they will quickly disappear under clipping and the aggressiveness of the stolons. Usually at the end of one week there will be many shoots two or three inches tall. If so the lawn should be mowed and again top-dressed in order that the nodes from the clippings may take root. The lawn should be clipped and top-dressed each time there are a number of tall shoots, as this treatment strongly promotes the vegetative propagation.

A spring-planted lawn should be fully developed by June 1, and a fall-planted lawn by May 10 or 15 of the following year.

As compared to seeding, vegetative planting

produces in two months a matured turf that is practically free from weeds, even in color and texture, and comparable to a single colored Brussell's carpet.

The soil required for a vegetative planted lawn is the same as for any bent lawn, and unless the stolons are kept at a putting green height, there is no more liability to disease, such as brown patch, than there is in a seeded lawn. In fact, young stolon shoots are much more resistant than young seedlings.

The care of the stolons will be discussed in Chapter IX, where the reader will find that as a long-time investment a stolon lawn is profitable.

## VII

### FERTILIZING

Food is essential to plant growth, but to believe that fertilizer is the panacea for all turf troubles is as wrong as believing the "little brown pill" will cure all the ills flesh is heir to. Fertilizer does not offset the effect of poor drainage nor will it make Timothy, Red top or a low grade lawn mixture into a lawn turf, or correct construction errors. On the other hand, the intelligent selection and careful application of fertilizer will surely improve the appearance and health of any lawn. Furthermore, it is far better to fertilize and encourage a poor lawn, than to plow it in and remake it.

A lawn should be fertilized with two objects in mind. (1) To replace in the soil the large amount of plant food that is removed in the form of clippings, and to restore the food elements that are lost by leaching from the soil. It is obvious that a close and frequent clipping of a lawn will cause it to need more

food, than if it is permitted to grow to a reasonable length and less frequently clipped. Also, the amount of plant food lost by leaching is greater in gravelly soils than in the heavier soils. (2) To provide the desirable grasses with food that is delectable, and to create a soil condition that is favorable for their development. Under such conditions any lawn grass will successfully compete with the undesirable grasses and weeds.

Grassses obtain their food from the air and soil. From the soil it is obtained through the roots and must be in a liquid form. Therefore the fertilizers used must be so constituted that they are soluble in water, or may be chemically broken down by soil bacteria and made available.

Grasses require seven elements from the soil: calcium (Ca), iron (Fe), magnesium (Mg), sulphur (S), phosphorus (P), potassium (K), and nitrogen (N). The first four are usually present in all soils that would be considered for lawn purposes, and seldom is it necessary to include them in the fertilizer. However, once in five years an application of lime that contains magnesium will be an insurance against a complete loss of calcium and

magnesium. Nitrogen, phosphorus and potassium are used in great quantities by the grasses and should be supplied to the soil annually.

Nitrogen, usually considered as ammonia ($NH_3$), is the element most used. An analysis of the clippings taken from the average lawn (10,000 square feet) will show that from fifteen to twenty pounds of nitrogen have been used in a season. It requires from sixty to eighty pounds of sulphate of ammonia to replace such quantities. More nitrogen is also lost by leaching, and such a loss must be considered in the fertilizer program.

Nitrogen promotes the growth of the leaf and stem, and the development of the stool, or crown. In the case of stoloniferous grasses such as creeping bent and Bermuda grass it greatly increases the rapidity of growth in the stolons.

Nitrogen is used in fertilizers in several forms:

1. **Organic Nitrogen** which is found in vegetable and animal matter.

2. **Ammonia Nitrogen** example, Ammonium sulphate $(NH_4)_2SO_4$.

3. **Nitrate Nitrogen** example, Nitrate of soda $NaNO_2$.

4. **Synthetic Nitrogen.** The nitrogen obtained from the air and combined with such elements as calcium, and carbon. Such fertilizers contain a very high amount of available nitrogen. Numbers 2 and 3 are classed as inorganic fertilizers.

All nitrogen to be available for the grass plant must be in the nitrate form. It is therefore obvious that nitrate of soda and certain synthetic fertilizers (those having the nitrogen in nitrate form) are the quickest acting nitrogen supplying fertilizers. Ammonia nitrogen must be converted by soil bacteria into nitrate nitrogen. The conversion takes place very rapidly and ammonium sulphate is second in rapidity of action.

Organic nitrogen is the most difficult to convert into nitrate form and therefore all organic fertilizers are slow to show effect, as compared with the inorganic fertilizers. Briefly, the process of converting organic nitrogen into nitrate nitrogen is as follows: During the process of decay of organic substances certain soil bacteria convert the organic nitrogen into ammonia, then another group of bac-

teria converts the ammonia into nitrate nitrogen. Some organic compounds give up their nitrogen more rapidly than others, and are known as quick acting, or quickly available, as compared with those compounds whose nitrogen is slowly available.

Nitrogen is usually expressed as ammonia in the analysis, and is the first element listed. To convert ammonia to nitrogen multiply the percentage of ammonia by the factor .82. To convert nitrogen to ammonia multiply by 1.215. Cottonseed meal is an excellent lawn fertilizer, but as the demand for this product is greatest by the dairy industry as cattle feed, the analysis usually found on the bag is in terms of protein, sugar, fat, etc. To convert protein into nitrogen divide the percent of protein by 6.25 and if the ammonia content is desired, by 5.14.

Excessive use of nitrogen undoubtedly increases the grasses' liability to disease.

Phosphorus (P) is the second most used element. For the plant it is available in the form of phosphoric acid, ($P_2O_5$), known to the fertilizer world as superphosphate. It produces strong root growth, especially in the spring and in young plants. Phosphoric acid, contrary to

its name, is not acid and it is to avoid such a possible misunderstanding that the term superphosphate is used. Phosphorus is the second element listed in the analysis. In turf culture, an excessive use of phosphorus induces a strong growth of clover and weeds. Phosphoric acid is fixed in the soil and there is no loss by leaching. This fact is one of the reasons why a lawn fertilizer should not contain too much phosphorus.

Potassium (K), as potash, increases the formation of starch, stiffens the stems and probably aids the turf in its resistance to diseases. Potash salts are very caustic and liable to burn the grass leaves. Very little potash is lost by leaching, and comparatively little used by the growing turf. Clover and weeds are favored by its excessive use.

Fertilizers should be purchased according to the price per pound of plant food, and not according to the price per ton of mixed fertilizer. To be able to do this one must understand the label analysis which is required by nearly every state in the whole United States. Such a label guarantees that a certain percentage of the fertilizer is available nitrogen (N) or ammonia ($NH_3$), phosphorus (P) or potas-

sium (K). Example a 6-8-6 mixture means 6% ammonia, 8% phosphorus and 6% potassium; or in 100 lbs. of the fertilizer, 20 lbs. is available as plant food in the indicated proportions. The remainder (80 lbs.) is filler composed of harmless materials. If the price of such a mixture was quoted at $80 per ton, the plant food would cost 20c per pound.

Having discussed at considerable length the plant food elements, let us consider the grasses themselves and their particular needs.

Bents prefer acid conditions, and many species produce stolons.

Blue grasses prefer alkaline conditions.

Fescues prefer slightly acid conditions and have much less leaf development.

TABLE VI—DESIRABLE PROPORTIONS OF AMMONIA, PHOSPHORUS, AND POTASH TO USE WHEN A COMPLETE FERTILIZER IS DESIRED.

| *Soil* | *Bents* | *Blue grasses* | *Fescues* |
|---|---|---|---|
| Clay, low in humus.... | 14–2– 2 | 12–2–2 | 8–2–2 |
| Clay loam ..... | 12–4– 2 | 12–4–2 | 8–4–2 |
| Sandy loam (Sandstone) | 10–6– 4 | 12–4–4 | 7–4–4 |
| Sandy loam (granite).. | 10–6– 1 | 12–4–2 | 8–4–2 |
| Average garden loam... | 14–4– 2 | 8–2–1 | 8–3–2 |
| Weedless lawn ..... | 6–5–16 | ..... | ..... |

Weeds do not thrive on acid soils because active aluminum is made available by the acid condition. Aluminum is toxic to weeds.

Clovers and weeds will sucessfully compete against grasses on alkaline soils and those containing much phosphorus and potash.

The weedless lawn formula was developed over twenty years ago by Dr. Burt L. Hartwell while he was Director of the Rhode Island Experiment Station. The formula is arrived at by mixing equal parts of sulphate of ammonia, superphosphate and muriate of potash. The rate of application is 750 pounds of the mixture per acre, or 17 pounds per 1000 square feet.

Southern lawn grasses do well in slightly acid soil, and cottonseed meal appears to be excellent for Bermuda grass.

In turf culture, lime should be used only when it is deemed necessary to increase the calcium and magnesium content of the soil, or to correct acidity, or in the case of clay soils to assist bacterial action. If lime is used in a quantity over 40 lbs. per 1000 square feet it will very likely cause an invasion of clover.

Fertilizers should be applied when the grass is dry and those that are caustic should be

## Table VII—Fertilizers Used on Lawns.

| *Name* | **Average Analysis* | *Notes* | *Rate of application per 1000 sq. ft. Pounds* |
|---|---|---|---|
| Ammonium Sulphate $(NH_4)_2SO_4$ ..... | 20 – 0 – 0 | Ac. *C.* Io. R. | 5 |
| Ammo-phos ..... | 20 –20 – 0 | *C.* Io. R. | 5 |
| Blood, dried ..... | 11 – 0 – 0 | N. O. M. | 10 |
| Bone-meal (raw)... | 4½–22 – 0 | N. O. S. W. | 18 |
| Bone-meal (steamed) ..... | 2½–50[1] – 0 | N. M. O. W. | 22 |
| Castor Bean Pomace ..... | 5 – 1½ – 1 | Ac. M. O | 21 |
| Cottonseed meal ... | 6½– 2½ – 1½ | Ac. C. M. O. | 16 |
| Guano ..... | 11 –15 – 0 | Ac. M. O. | 10 |
| Manure (stable) .. | 1 – 1½ – 1 | Al. M. O. W. | 50 |
| Milorganite ..... | 5½– 2½ – ½ | Ac. M. O. | 15 |
| Muriate of Potash.. | 0 – 0 –48 | Ac. *C.* Io. S. W. | 6 |
| Nitrate of Soda.... | 16 – 0 – 0 | Al. *C.* Io. R. W. | 5 |
| Nitrophoska ..... | 18 –30 –15 | Al. *C.* | 4 |
| Peat ..... | 2½– 1 – 2 | N. O. S. | 40 |
| Poultry manure ... | 5 – 3 – 1 | Ac. C. O. M. | 15 |
| Sheep manure ..... | 2 – 1 – 2 | Al. O. S. W. | 20 |
| Sulphate of Potash. | 0 – 0 –48 | Ac. *C.* Io. S. W. | 6 |
| Superphosphate ... | 0 –16 – 0 | Io. N. S. W. | 12 |
| Tankage ..... | 9 –15[1] – 0 | Ac. O. M. | 12 |
| Urea ..... | 45 – 0 – 0 | *C.* N. O. R. Sy. | 1½ |
| Wood ashes ..... | 0 – 0 – 4 | Al. O. S. W. | 30 |

Notes—Ac—acid; Al—alkaline; C—caustic; *C*—very caustic; Io—Inorganic; M—medium rapid; N—neutral; O—organic; R—ready available; S—slow in action; Sy—synthetic fertilizer; W—encourage weeds. (1)—Bone phosphate.

*Expressed as nitrogen N, phosphoric acid $P_2O_5$, and potash $K_2O$.

thoroughly worked into the soil by a heavy sprinkling. During the washing in process, if possible avoid walking on the wet lawn. The great liability of burning the grass is the only objection to the Rhode Island formula. Spreading fertilizer in the rain is safe provided the storm lasts long enough to wash the solution from the leaves.

If one has screened compost, the caustic fertilizers may be mixed with it at the rate of from five to eight pounds per cubic yard of compost. Such a mixture will be much more effective if allowed to remain in the pile for a week before applying to the lawn, and it should then be applied at a rate sufficiently heavy to assure the proper amount of fertilizer per square unit.

The frequently clipped lawn should have three applications of fertilizer each year. The first in the spring after the young shoots have become hardened, a second about June 1, and a third in early September if there is little danger of loss from leaching.

Poultry manure if taken from the dropping boards and composted with sand for six months is an excellent lawn fertilizer. It

TABLE VIII—SAFE AND RELIABLE FERTILIZERS. RATES PER 1,000 SQUARE FEET.

| *Spring* | *June* | *Fall* |
|---|---|---|
| 1. Ammonium sulphate 5 lbs., and Castor bean pomace 21 lbs. or Cottonseed meal 16 lbs. | 1. Same as spring | 1. Castor Bean pomace 21 lbs. or Cottonseed meal 16 lbs. |
| 2. Ammonium sulphate 5 lbs., and Bone meal 10 lbs. | 2. Same as spring | 2. Bone meal 10 lbs. |

Number 1 for bents and fescues, Number 2 for blue grasses.

should be applied at the rate of 25 lbs. per 1000 square feet.

Much is to be said in favor of the ready mixed commercial lawn fertilizers. First they are sold in convenient packages (10 lbs. and up.) Second, they have a guaranteed analysis the same as all fertilizers. Third, they are usually mixed, so that their plant food is made slowly available and therefore lasting over a long period of time. Fourth, if used according to directions there is very little liability

of burning the grass, and fifth, they can be used on shrubs and flower beds without harm. As an increase in the amount of quickly available nitrogen in a commercial mixture would give cause for caution in spreading, because of the liability of burning the grass the practical agrostologist accepts the commercial fertilizer ratios as safe and sane, even though not ideal. The home owner who knows how to use ammonium sulphate can have an excellent lawn fertilizer by using it as a supplement to a commercial mixture.

### Warning!

If the directions say use 10 lbs. per 1000 square feet don't use any more; many a good lawn has been ruined because the owner or caretaker thought that if a 10 pound application was good a 20 pound application would be excellent.

## VIII

## CONTROLLING PESTS

For discussion in this book, turf pests may be classed in one of three groups. (1) Herbaceous plants, or better known as weeds and undersirable grasses. (2) Animal and insect pests, and (3) Fungus diseases. Of course there are many other pests, such as the habitual divot taker on a golf course, a scratching dog on the front lawn, and the lazy and careless cross-cut taker who makes paths. These latter present local problems and need not be specifically prescribed against.

In turf culture there are four cardinal principles for pest control:

1. Neither animal nor plant pests will remain where food or environment is displeasing.

II. A thorough knowledge of the life history of a pest is necessary, that it may be attacked during its most vulnerable condition.

III. The visible appearance of one pest often indicates the presence of another.

IV. Well-fed and vigorous turf will successfully compete with foreign herbaceous growth, and is much less susceptible to attack by fungus diseases than weak and thin turf.

Too often herbaceous lawn pests have their origin coincident with the making of the lawn. It is therefore necessary that the first pest control measures should start at the time of building the lawn.

Some of the most important herbaceous pest control methods have been discussed in the preceding chapters.

A well prepared seed bed helps to assure that the young grass plant will have a well developed root system and a strong leaf growth. (Chapter III.)

The selection of high quality seeds of varieties of grasses that are adapted to lawn conditions, especially to the individual lawn area, means the young grass plants are given a start in congenial surroundings. (Chapters IV and V.)

The use of a complete fertilizer having a suitable nitrogen, phosphorus, potash ratio and causing a soil reaction that is favorable to the growth of the basic grass is very essential to pest control. (Chapter VII.) It pro-

vides for the grass plant a health-giving diet and assures the continuance of an agreeable environment.

If the suggestions in the above paragraphs are followed, the result should be, a thick and vigorously growing lawn from the beginning. It is obvious that in thick turf there cannot be room for weeds or undesirable grasses and it has been demonstrated many times that vigorously growing grass will crowd out weeds.

In theory the correctly started and properly fed lawn should be weedless forever. However, in practice such a condition is seldom found. However, correct cultural practice does reduce the weed content of a lawn to an extremely low figure. Also, there are many lawns that have had a "bad start" and whose owners wish to "fix up." The problem with such lawns is not how to keep the weeds out, but how to get them out.

All herbaceous pests can be eliminated from a lawn by digging and pulling them out. But if the pest is present in a considerable quantity such methods are radical and often require a rebuilding of the entire lawn. Furthermore, they are unpractical and usually unnecessary.

It is far better to feed correctly and en-

courage the existing grass in a lawn and cause it to crowd out the pests than to spade it up and start anew. For by continued correct fertilization and cultural methods the existing grass ( a valuable asset) is becoming stronger and the soil fast becoming nearer to the ideal condition. On the other hand rebuilding a partially worn lawn is only a temporary relief from herbaceous pests, and adds nothing to the future value of the soil.

What does the presence of herbaceous pests in a lawn indicate? A large number of weeds in a year old lawn usually indicates that either the seed used was of poor quality, or of varieties not adapted to lawn conditions, or faulty construction of the lawn area, and too often all three conditions. Any one of these reasons is sufficiently strong to warrant the entire rebuilding of a lawn. The loss of time would be only one year and the cost would be quickly offset by the lower maintenance cost a good lawn has over a poor lawn. Also there would be the great satisfaction of having "done the job right."

The appearance of weeds in a three year old lawn can mean but two things. Either the varieties of grass selected are not adapted

to close clipping or to the local conditions and are becoming thin, or the fertilizers used were of such nature that the weeds were being "better fed" than the grass. It is usually unwise to rebuild such a lawn, but it is very obvious that if fertilization is at fault a change of diet is necessary. If the grasses cannot withstand the close clipping required on a lawn the area should be renovated (see next chapter) and seeded with a grass that is known to be adapted to the local conditions.

The appearance of weeds in a ten year old lawn that has been practically free from weeds is an indication that the physical condition of the soil is becoming intolerable to the grass; or perhaps small bare spots or holes have been made by persons walking on the lawn and weeds have obtained a foothold in some of these spots. In a lawn of this type if the weeds are few in number they had best be pulled out, but if they have gained a considerable foothold other methods of control should be adopted.

## Common Weeds that are Liable to Infest Turf

Numbers indicate as follows: 1. Usual source of contamination. 2. Habits of growth. 3. Best season to attack. 4. Cultural practices to check the growth. 5. Chemicals used as control. 6. Particular significance.

**Mouse-ear chickweed** (*Cerastium vulgatum,* L.)—(1) Impurity in grass seed, loam top-dressing. (2) Annual or biennial, creeping, leaves hairy, dark green, shape and size like a mouse ear. (3) Spring or fall. (4) Severe raking with sharp toothed rake, or cutting out and resodding the scar. (5) Ammonium sulphate dusted on the leaves, or the leaves painted with a concentrated solution of ammonium sulphate. Twenty-four hours after sulphating thoroughly soak the dusted areas to wash the chemical into the soil. Some grass will be burned by this method but the injury will not be permanent. Recent experiments indicate that chick weed can be eliminated from a lawn by the use of arsenate of lead with or without a loam top-dressing. The rate of application is 5 lbs.

of arsenate of lead for every 1000 square feet of lawn surface. Arsenate of lead is a deadly poison if taken internally and must be handled with caution.

Plantain, Buckhorn (*Plantaga lanceolata*, L.) Broad leaved plantain. (*P. Major*, L.)—(1) As an adulterant in grass seeds and adjacent fields. (2) Perennial. Buckhorn has a narrow lance shaped leaf which is nearly prostrate. The broad leaf carries its leaves quite erect. (3) No special season. (4) Thorough loosening and aeration of the soil by spiking or forking, or digging out. (5) No chemical treatment suitable, but the continued use of ammonium sulphate will effectively check its growth. (6) Indicates a tight hidebound soil or an alkaline soil.

Dandelion (*Taraxacum officinale*, Weber)—(1) Neighboring fields. (2) Hardy annual, tap rooted. (3) Spring, just as blossoms are forming. (4) Use acid reacting fertilizers. (5) Where there are many plants spray with iron sulphate, 1½ lbs. dissolved in one gallon of water. Spray with a mist, one gallon to cover 175 square feet. Area will turn blackish in color but grass will recover quickly. If a second spray is needed apply it ten days

after the first. Individual plants may be dug out, or the crowns cut off and roots burned with a pinch of sulphate of ammonia. (6) Indicates a loose and open turf with many holes.

**Witch Grass, Quack Grass, Couch Grass** (*Agropyron repens,* L.)—(1) Adjacent fields. (2) Has creeping underground stolons. (3) Spring. (4) Very close and frequent clipping will usually subdue this pest so that the good grass can crowd it out.

**Crab Grass Large** (*Syntherisma sanguinalis,* L.) *Small* (*S. Ischaemum* Nash)—(1) Impure seed, and reseeding, also adjacent lawns. (2) Annual, purplish blossoms in the fall. (3) Spring, late summer and after frost has killed it. (4) Thickening of turf in spring before crab grass starts (late May). Raking out the plants before they have gone to seed, and top-dressing with loam and seed, or heavily raking the infested areas after the frost has killed the crab grass, and top-dressing with loam and seed. (5) No effective chemical control. (6) Indicates a thin and open lawn.

**Moss**—Usually indicates the lack of soil fertility particularly a depletion of potash. If the moss is not a solid mat it will usually disappear after three applications of muriate of

Creeping bent stolons grow very rapidly. The "Pelt" of turf at the left grew in four months from a rooted node similar to that at the right

THE FAIRWAYS ON WELL MAINTAINED GOLF COURSES ARE EXCELLENT EXAMPLES OF WELL-FED TURF

potash applied 6 lbs. per 1000 square feet. If the soil is heavy or wet, draining and aerating the soil will check the growth of moss. Moss does not necessarily indicate an acid soil.

**Clover** (*Trifolium repens* L.)—(1) In original seed mixture, or from adjacent fields. (2) Creeping by rooting of branches, Legume. (3) Fall. (4) Very severe raking and the use of acid reacting fertilizers. (5) Dusting with ammonium sulphate. (6) Indicates an alkaline soil or one with a considerable amount of phosphorus and potash in it.

Other herbaceous pests that may invade lawn turf are:

**Yarrow** (*Achillea millefolium* L)

**Thyme-leaved Speedwell** (*Veronica serpyllifolia*)

**Carpenter Weed** (*Prunella vulgaris* L)

**Dichondra** (*Dichondra repens*) (South only)

**Goose-grass** (*Eleusine indica*)

All of the above weeds are most effectively removed by digging out, and in most cases that means removing a square of turf containing the weed and replacing it with a clean sod.

There are very few animals that are classed as pests. Skunks are blamed for digging small

shallow holes all over the lawn, but they should be given credit for the grubs and beetles they get from the holes. Skunk holes on a lawn is a warning that white grubs are in the lawn and may some day do serious damage to the turf.

Moles do not eat grass roots, they are strictly carnivorous. They damage the turf by digging under the roots and causing the turf to dry out. Their burrow marks are unsightly and on a golf course present an unfair hazzard. As it is practically useless to try to tempt moles to eat poison bait, one must either trap them or asphyxiate them with poisonous gases.

The common verticle spring trap that is sold at all hardware stores is probably the best trap yet devised. To successfully operate it one must be sure that the trigger spoon is placed over the center of the runway and at just the right height to give the mole no hint that his runway has been disturbed.

The gasses, carbon dioxide, and cyanide are very effective, but they are very dangerous to handle and not to be generally recommended.

An inexpensive and effective method of eliminating the mole is to cut an old inner

tube, fasten one end to the exhaust pipe of an automobile (any make) and the other end to a hose. Carefully insert the hose in the central part of the runway. Be sure the run is not blocked by falling earth so as to prevent a free flow of the exhaust gas (carbon monoxide). Let the automobile engine run slowly for twenty minutes and Mr. Mole is painlessly killed. Mole runs should be tamped (after the mole has been killed) and thoroughly watered so as to hasten the rooting of the lifted grass plants.

Angle worms seldom are annoying to a lawn, but on a putting green their casts make accurate putting impossible. Also the casts have a way of smothering out the grass. Angle worms can be quickly taken from a lawn by using any of the several commercial worm eradicators or by using a solution of mercuric chloride. If a commercial preparation is used the *printed directions* that come with each package, bottle, or can should be followed exactly.

A mercuric chloride solution is made by dissolving ½ oz. mercuric chloride (bichloride of mercury) in 15 gals. of water and sprinkling the solution over the worm infested area so

that one gallon will cover about 25 square feet. The application of the solution should be followed at once by a heavy sprinkling by a hose with a nozzle attached to it. The worms will appear in a very short time and should be swept up. They are not suitable as fish bait. Earth worms only bother in heavy and rich soils.

Ants are difficult to eliminate. Single colonies can be exterminated by injecting a few drops of carbon disulphide through the entrance. The large colonies known as ant hills can be destroyed by punching small holes about eight inches apart throughout the entire area. Into these holes as fast as they are punched pour *through a funnel* a tablespoonful of carbon disulphide and immediately cap the hole with moist earth. Carbon disulphide is very inflamable and fire must be kept away from it. Also, it will kill all plants with which it comes in contact.

The white grub which is the larvae of the June beetle occasionally becomes a serious pest in turf. Its presence is detected by the grass turning a lifeless color, usually in large circular patches. If one pulls at the discolored grass he will find that the grass lifts easily and

in mats. The grub has cut the roots just below the crown.

An easy, effective, and inexpensive method of getting rid of this pest is to apply arsenate of lead to the entire lawn area at the rate of five pounds per 1000 square feet. It will be easier to apply if the arsenate of lead is mixed with sifted loam or sand. It is not necessary to wash the arsenate into the soil but its effect will be hastened if it is done.

The larvae of the Japanese beetle (now confined to a small section on the Atlantic seaboard) works in the same manner as the white grub only faster and more thoroughly. Arsenate of lead is the effective poison for this pest also.

To date only three fungus diseases are seriously affecting the lawn turf. Snow mould is the first to appear coming at the time the snow is melting. It causes the grass to appear matted and to be covered with a grey slimy mould. These patches vary in size from six inches in diameter to two feet and are irregular in shape. For the home owner the practical control method is to vigorously broom the diseased spots as soon as they appear.

Large brown patch is liable to appear on

bent turf any time between April and October, however, it seldom makes more than five appearances in lawn turf during any one season. Brown patch is detected by the "smoke ring" that appears on the grass after the dew has dried, or by the fine cobweb-like ring that is visible before the dew dries. The size of these rings vary in diameter from that of a tea plate to a wash tub. There are several commercial fungicides for use against brown patch. If the directions are followed these will be very effective both as prevention against attack and as a check after the fungus has started. If for any reason a home owner can not use the commercial fungicides the development of fungus can be effectively checked by brooming the "cobweb" circle in the early morning.

Small brown patch or dollar patch as it is called is more deadly than large brown patch. Its presence is detected by the appearance of a number of dead spots about the size of a silver dollar and up to four inches in diameter. This fungus seldom seriously attacks long grass but is very likely to attack putting green turf. The reason for small brown patch appears to be similar to that of the large brown patch,

and the commercial fungicides used for control are the same as for the large brown patch. Again vigorous brooming of the spots will be found to be beneficial as a control method.

# IX

## GENERAL MAINTENANCE

In the practice of turf culture the word "maintenance" is universally misused. The dictionary meaning is "to hold or keep in a particular state." In turf culture it is interpreted to include true maintenance, general improvement of the turf, and the rehabilitation of a partially destroyed lawn.

Whatever the interpretation, good construction will greatly lessen the cost of maintenance. Also it is far better, and much cheaper, to encourage and improve the existing turf on a lawn area than to re-make it. Too often the errors that caused the lawn to fail in the first instance are repeated in the re-building. Also if there is some grass growing, good maintenance methods will cause more grass to grow.

Good maintenance will never entirely overcome the handicaps of a poorly constructed lawn, nor will good construction diminish the need of correct maintenance methods in turf

culture. All maintenance methods should have two objectives: one, to relieve the immediate troubles of the turf; two, to be of permanent value. Unless these two objectives are kept in mind it is very easy to cause considerable injury to a lawn, and at the same time satisfy an immediate need. Incorrect watering is an example of how such a condition could be brought about.

## Fall Maintenance of Northern Turf

Because the northern turf grasses prefer a cool temperature for their growth, there is in the fall an increased growth of leaf and a general freshening appearance on all turf. This revival of vigorous growth is the reason for careful fall maintenance.

Some organic fertilizer that has an analysis of about 7% ammonia, 2% phosphorus and 1% potash should be applied during the early part of September. After September 1, the lawn mower knife should be lifted one-half inch above the usual heighth for spring and early summer cutting. The mowings during the first half of September should be frequent enough to prevent matting of the clippings,

and all clippings should be left on the lawn. During the latter half of the month the mowings should be less frequent, and timed so that the last mowing of the season will be made about a week before the grass ceases to grow. At the Massachusetts Agricultural College at Amherst the final mowing of the season has been made during the last week of September in sixteen of the last eighteen years. The exceptions were twice during the first week in October. Both of these occurred in years that had exceptionally dry summers. There are three reasons for permitting the grass to go into winter in a somewhat long and untidy condition: (1) By so doing more carbo-hydrates are stored in the roots for early use in the spring. (2) Protection is afforded against the early thaws causing the grass to start too early only to be killed by the late spring frost. (3) The grass crowns are protected against injury by being tramped upon. The ideal length for the grass to enter the winter is just short of the "lopping over" length.

The thick rough on golf courses can be improved by being burnt over in the late fall, but

such a practice is not advisable for lawns or the better turf areas.

### Fall Maintenance of Southern Turf

Lawns planted to Bermuda grass or St. Augustine grass should be given a severe raking to loosen the soil, and seeded with Italian rye grass at the rate of from one-half pound to one pound for each one hundred square feet of turf. The rye grass will give body and color to the lawn during the winter months that are too cool for the Bermuda grass. October is the proper month for seeding with Italian rye grass.

### Winter Maintenance

The only protection that a lawn needs in winter is against trespassers. A path across a lawn can be made very quickly in the winter if there is little or no snow. Also, if a path is made in the snow on the lawn, the turf under the trodden snow is quickly injured. Paths made during the winter are seldom obliterated before June unless very special care is given them.

A winter mulch of manure, straw, hay, or even tobacco stalks has been found to be unnecessary and in many instances harmful. If one cannot resist the temptation to "protect" the lawn, the mulching should not be done until after the ground has become solidly frozen.

## Spring Maintenance, Northern Turf

Spring time for the lawn presents a series of short but very important periods in its development. Snow mould, discussed in the preceding chapter, if present, will appear at the edges of snow banks as they melt away. It should be taken care of at once.

Winter-killed spots must be dried out by roughing the soil surface, and as soon as the soil is dry, seed should be sown even though there is a possibility of the seed or young grass plants being frozen by the late spring frosts.

Trespassing is "positively forbidden" on any turf when it is covered with a white frost. The grass is so sensitive to being tramped upon at that time that anyone walking across it would leave footprints that would be visible

for weeks afterward. Any tracks made on the frosted lawn appear as darkened and smut-colored areas. Grass thus injured is quite likely to be killed by excessive summer heat.

As soon as the lawn is sufficiently dried to permit its being raked, it should be thoroughly combed with an iron-toothed rake. Dead grass, leaves, cigarette papers, and all debris collected during the winter should be removed.

Burning the lawn in the spring may appear to be beneficial, but in reality it is very injurious to lawn turf.

Probably the most critical period for the lawn in the spring is the rolling period. The soil must be neither wet nor dry—it must be damp yet friable. Such a condition usually exists for only a few days and at no set period in the spring. One must watch for the condition. The roller used should be heavy enough to press the grass crowns into the soil and to compact the soil, thus eliminating the air pockets caused by frost heaving. Roll the lawn once in the spring and then put the roller away until the next spring.

The first mowing of the season should be made with the lawn mower knife set a half inch above the normal summer heighth. It

is usually necessary to make the first clipping during the last 10 days of April.

### Spring Maintenance, Southern Turf

Bermuda grass lawns, whether winter seeded to Italian rye grass or not, are greatly benefited by a biennial renovation. This renovation is best accomplished by harrowing the lawn with a disc harrow regulated to cut deeply but not furrow. After harrowing, the area should be raked so as to remove some of the old and coarse stolons, and then rolled with a light roller.

### Summer Maintenance

The more frequently a lawn is clipped the more fertilizer, especially nitrogen, is required. Therefore if one does not intend to fertilize a lawn well he must not expect it to thrive if he clips it frequently. No turf except putting greens, or bowling greens, should be clipped daily or by a regular calendar schedule. Measure the height of the grass when the lawn looks healthy and well-kept, yet not freshly mowed. Set the lawn mower to cut one-half

inch below that heighth and clip the lawn only when the grass has grown one-half inch above this optimum heighth. By following this rule, the lawn is never too long nor too short for its health, and there will be no clippings to show mats or to be raked. During very hot periods the lawn mower should be put down cellar (it will be too hot to mow, anyway) and the lawn permitted to grow taller than in the growing season. Upon returning the lawn mower to use, the blade should be lifted a little for the first mowing after a dry spell. All clippings should be allowed to remain on the lawn unless they appear matted after 36 hours, and then only the mats should be removed.

## Watering

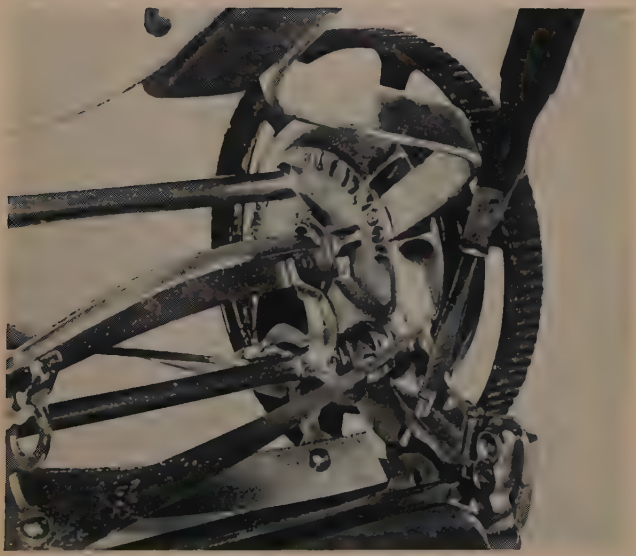
Water should be artificially applied to a lawn only in such a manner and at such time as to assure a *normal rainfall for the locality*. Short daily sprinklings cause a major portion of the grass roots to remain very near the surface of the soil, which is quickly dried by the sun and wind, thus leaving the grass roots hot and dry until the next daily sip of water. In the early spring, grasses having a large portion of their

roots near the surface are very likely to start to grow during an early thaw and later to be severely checked or killed by a late spring cold snap.

The often-quoted phrase "the more water I put on my lawn the drier it seems to get" is really true. Excessive watering causes channels to be made directly to the subsoil, and if the subsoil is gravel much of the water is lost. Also, as soon as the watering ceases these channels become vents which cause the top soil to dry out. Clay soils that have become cracked are also full of air vents which cause further drying of the soil.

Only an unusually dry soil need be watered oftener than once a week, and the correct amount of water to apply is 80% of the water-holding capacity of the soil. In other words, the turf after watering should be wetted several inches deep, and yet not to a depth to cause excessive leaching. The water should be applied in small drops supplied as rapidly as the soil absorbs them and no faster.

Greenkeepers often operate sprinklers in one location all night, or the equivalent of four to six inches of rainfall. Such a practice is a serious mistake in most instances.



*Above*—When testing the sharpness of mower knives use thin paper held perpendicular to the bed knife

*Below*—Adjusting screws. Be sure to loosen one before tightening the other

THE GREENSWARD OF A PARK

## Turfing or Sodding

The conditions leading to successful sodding or turfing are: (1) Thin turf, (2) small sods, preferably one foot square, (3) protection of roots (not leaves) during the transplanting process, (4) a smooth and soft sod bed, (5) well-sanded or loamed joints between sods, and (6) careful watering.

Thin turf (one inch or less) will send roots into the sod-bed in three or four days after being placed. The grass therefore loses very little water or nourishment. On the other hand, thick turf may take two weeks to send its roots to the sod-bed.

Small sods cut in squares handle easier and lay better than rolled sods. There is less waste and the joints are tighter.

If sod is to remain unlayed for any time it should be placed roots down to prevent drying.

The sod-bed should be free from stone, firm and well-loosened on top, so that the sod will lie smoothly in the bed rather than on it.

Sods should be tightly pressed against (not on) each other and all joints filled with fine sand or light loam. Sand is preferable to loam,

and clay loam should not be used. The sand should be applied to the joints though they appear tight soon after the sod is laid, as sod usually shrinks the second day after laying, and if cracks are permitted they serve as chimneys for drying air. Clay will cake in the cracks and lose its usefulness.

Watering should be done after sodding and not before, and only a sufficient amount of water applied to prevent the sods from shrinking. Too much water will cause washing out of the crack fillers and bulging of the newly laid sod.

Sods should be firmly tamped into the sod bed, but never rammed. It is better to tamp too lightly than too hard.

## Paths and "Hide Bound" Turf

A battalion of soldiers in company front could march over a field of turf without any apparent injury to it. One company marched in column of twos would make a path that would be difficult to obliterate. Therefore if you must cross the lawn daily select a different route each time.

Paths and "hide bound turf" are very much

alike. In both instances the air and rain water have been excluded from the grass roots and they cannot function properly. Because the roots fail to do their work, the leaves and crowns become weak and are easily destroyed by mechanical injury.

The turf in paths and "hide bound" areas can be much improved by being spiked with a spiked tamper. The purpose of spiking is to puncture the hard and tightly-packed surface soil so that air and water can get through. If the soil be clay or heavy loam a dressing of sand brushed into the spike holes will help to retard the recurrence of the condition.

## Renovating Turf

Only a lawn that is growing on a reasonably good soil should be renovated; otherwise it should be rebuilt.

To renovate turf is to clean the turf as far as possible of undesirable vegetation and to open the soil to give the grass a clean and fresh bed.

To rebuild a lawn is to turn it under and reseed. It is therefore quite obvious that on poor soils it is better to turn the turf in and

make use of the organic matter contained in the vegetation.

Renovating does not destroy the contours or original design of a lawn, but rebuilding usually destroys both.

Renovation, if necessary, should start in the early fall in the north, and early spring in the south, and should be completed as soon as possible. Large lawns had best be harrowed with a disc harrow, having the discs set straight. The harrowing should be thorough and in two directions at right angles to each other. After discing, the area should be scratched with a weeder. The weeder serves two purposes, to tear out partially loosened plants, and to rake the surface. Raking by a weeder must be followed by hand raking, which should remove only such plants as are uprooted. After raking, seed should be sown at about two-thirds the rate for new seeding. Rolling should follow the seeding.

Small lawns are renovated by being thoroughly raked with iron rakes.

A lawn may be successfully renovated if it contains twenty-five percent or more permanent grass plants, such as bents, fescues, or blue grass.

## Wet Spots and Dry Places

Areas that are continually wet should be drained by tiling. There are, however, very often low spots that are difficult to drain. Such wet spots are very often drained by exploding a small charge of dynamite in the subsoil. If the dynamite is well within the subsoil it will usually shatter the subsoil so that excess water will percolate through to a lower stratum and there be drained away. Dynamiting will in no way injure the surface of the soil if the hole is deep and the charge is small.

Hidden rocks, buried construction debris, or very thin top soil over a gravelly knoll, cause a majority of the dry spots in turf. If these causes are removed and the void filled with soil the moisture can be retained and the dry spot disappears. If a ledge is near the surface, its effect upon the soil moisture can be greatly lessened if the soil is removed and the ledge coated with heavy loam or sifted hard coal ashes. At least three inches of loam should be spread over the ashes if satisfactory turf is expected.

## Recovery of Meadow Land

Very often meadow land or old hay fields can be quickly converted to a very fair lawn by frequent clippings beginning early in the spring accompanied by the application of fertilizers having a high nitrogen ratio.

# X

## LAWN MOWERS

A HAND lawn mower should be adapted to the lawn it is to mow and to the person who is to operate it. It is because the merchants and their customers have failed to consider the points of efficiency that the lawn mower is the most disliked implement about the home, especially in the summer time.

If the lawn is level and open, a 20-inch width of cut may be used but under the ordinary conditions a 16 or 17 inch machine will be most satisfactory.

A heavy person cannot operate a light machine with ease, nor can a light person efficiently push a heavy machine. A good rule is that the machine should weigh about one quarter of the operator's weight.

The roller bracket bolt is very apt to loosen, and if either the roller bracket or machine bracket is of the slot type, a loose bolt will permit the brackets to slide causing an un-

even heighth of cut. Brackets that are drilled with holes are best, as the adjustment is held though the bolt may be loosened.

A roller bearing either tapered or straight, is the most satisfactory bearing for the reel. Plain bearings that are long and bushed with a bearing metal are also very satisfactory. Ball bearings are excellent if the balls are large (3/16″) and well housed, but small balls poorly housed soon become clogged with grit and lose their efficiency. Low grade plain bearings are not to be considered. The bearing adjustment should be automatic or easily accessible and the adjusting screw provided with a lock-nut.

Large diameter reels will cut long grass easily and well. The reel should be four or five (preferably five) bladed and five and a half or six inches in diameter.

The gearing should be such that while the mower is going forward 31 inches, twenty-four to thirty reel knives should pass across the bed knife. This is called frequency of cut.

There should be two reel knives on the bed knife at all times to assure the smooth operating of the machine. Three knives would make for smoother operation but the machine

would push hard. Machines that for brief intervals have no reel knife on the blade should not be purchased.

There should be no less than three reel spiders and four will assure a more sturdy reel. The reel spiders are the pieces that hold the reel knives. There should be a full reel spindle and not merely the bearing ends. Each reel spider should be securely fastened to the spindle, to help distribute the cutting load to all parts of the machine and to stiffen the reel unit.

A wheel ten inches in diameter is the optimum size. Small wheels follow the bumps in the lawn too closely and also cause the machine to push hard. Larger wheels are bothersome around shrubbery.

The mower having a set of gears arranged in a train is known as a train gear machine. Its advantages over the common type (single pinion) are its longer wheel base and better placed handle braces which make for a less "jumpy" machine. Also the train gear machines have more and heavier pawls.

Only a few of the many points of efficiency in a hand lawn mower have been mentioned, but their careful consideration should help

in selecting a machine adapted to the job and to the operator.

The average home owner clips his lawn 18 to 20 times each season. It is a large lawn that requires two hours time to mow. Therefore a lawn mower is used only 36 to 40 hours a season by the average home owner. With reasonable care a best grade lawn mower should last 350-400 hours without a major repair, and from 800-1000 hours before it is ready to be discarded.

With each new lawn mower purchased are directions for "sharpening" (I prefer to call it whetting or honing) the machine. If the directions are followed good results will be obtained. A machine should be honed after every 100 or 125 hours of active use under ordinary conditions and sharpened every 200-250 hours. The sharpening should be done at a reliable lawn mower service station. Never attempt to sharpen a lawn mower with a file, for it is very difficult to get the reel knives true. A file may be used to remove burrs caused by hitting stones or metal.

The bearings should be kept snug at all times. Never attempt to adjust the cutting units without first trying the bearing adjust-

ment. The bearing adjustment may be tried by grasping the reel spindle in the center and lifting it. If there is up and down play, adjustment is needed. End play in the reel is necessary and unless it is too great may be overlooked.

A very light oil is best suited for the average lawn mower, and the machine should be oiled frequently as there are many opportunities for the oil to flow away, and when mowing in wet grass much water gets to all parts of the machine.

After each mowing the machine should be cleaned by brushing or washing. If it is washed it should be dried slowly.

When storing the mower for the winter, either hang it or place it on wood blocks so that air can circulate about it. If the machine is to be stored on an earth floor it should be placed on wood blocks and reversed so that the bed knife is above.

There are many types of the small power operated lawn mowers. The machines are being made more efficient each year, and like the automobile, one gets just what he pays for when purchasing one.

The success of the power driven machines

lies with the operator. He must not engage the clutch so quickly that it grabs and causes the wheels to spin. Corners must be turned carefully to avoid scuffing the turf, and it is especially necessary that the knives of power operated machines be kept sharp.

To illustrate the effect a lawn mower may have upon the grass, the following experience is related. The writer was asked the cause of a general blackening of the grass following each mowing. Examination of the grass blades showed that at least one-half inch of each grass blade had been bruised or pinched. Examination of the lawn mower disclosed the fact that the knives were very dull and were pinching the blades off instead of cutting them. The blackening of the grass ceased when the mower was sharpened.

When adjusting the cutting units be sure that they are far enough apart to permit a thin piece of tissue paper to pass between the reel knife and bed knife, when the paper is in a horizontal position. When trying the knives with paper, be sure that the paper is perpendicular to the bed knife, as the grass is. When properly adjusted the reel should spin freely.

## XI

### PARK TURF

Good turf is as much essential to a park as it is to a golf course, and because of its diversified use requires careful management for each area.

Park superintendents should not use the same cultural methods for their park turf as the greenkeepers do for their golf courses, and if a park has a golf course, the necessity for separate maintenance is most essential. Many parks have turf that is in poorer condition than it should be, because the superintendent has tried golf course methods on his lawns.

The greenswards of a park are for unorganized play, lounging, and picnicking, and particularly to add to the general landscape beauty of the park. To clip them as closely and frequently as fairways are clipped is wrong. No "brassie lie" is required, rather, a thick and somewhat long grass is needed to give comfort to the lounger and picnicker,

and a short clipped greensward certainly does not harmonize with the natural beauty of the park. The minimum height of cut in lawn-mowing park greenswards can well be three quarters or one inch higher than on fairways. A mixture of six parts Kentucky blue grass seed and four parts of Rhode Island or Colonial bent and three parts of Italian Rye grass should make a good park greensward.

In much used sections of a park, and particularly in the shaded areas, the health of the turf does not depend so much upon the soil and fertilizer as it does upon the amount of air in the soil. Constant tramping by the visitors so thoroughly packs the soil that the air is driven out, and the surface rendered impervious to water. A turf in such condition must be aerated by spiking, discing or lifting before much benefit can be obtained from fertilizers. Lifting the turf is accomplished by pushing a spading fork deeply into the soil and gently pressing down on the handle. The fork should enter at an angle of about forty-five degrees and deeply enough to be well below the grass roots. Air should be allowed to circulate through the soil for twenty-four hours, after which fertilizer should be applied

and the area well soaked. Two liftings a season, one in the spring and again in the late summer will keep a reasonably good turf on a much trampled area.

Where the turf is subjected to considerable tramping heavy tractors should not be used to draw the mowers, or if they are, they should be provided with extra wide wheel tires.

No turf can grow about stationary settees, drinking fountains, waste cans or any similar place, and a good park superintendent provides fine gravel or stone chips as a substitute.

Bowling greens and croquet courts require very close and frequent clipping to maintain a good playing surface. They must be fertilized frequently with a high nitrogen fertilizer such as sulphate of ammonia and at least twice annually with an organic fertilizer such as cottonseed meal. Croquet courts if built of heavy loam will become very hard unless treated with charcoal (150 lbs. per 1000 square feet) or a similar substance each spring and fall. The bents are the grasses best adapted to bowling greens and croquet courts.

Sport fields require a still different treatment, and here again the turf must not be permitted to become hard and impervious.

Football, soccer and cricket fields can be permitted to grow rather long, but a baseball diamond must be cut closely (one inch). A mixture of four parts Chewings fescue, one part Rhode Island or Colonial bent and one part red top is well adapted for play fields situated on acid or neutral soil.

The "distant," "vista" or "meadow" turf should consist of such grasses as meadow fescue, and meadow foxtail, if the soil is very wet, and red top and meadow fescue on other areas. These grasses if mowed three times a season with a hay mower will give a very pleasing meadowland appearance.

Canadian blue grass can be used in parks to a good advantage on the areas that are hard and clayey. It should not be used alone but with fescue or Kentucky blue grass.

## XII

## CEMETERY TURF

A CEMETERY turf is the least worked of any public or semi-public turf. With the exception of Memorial Day, traffic is very light, and it is never violent. Few divots are taken and it is seldom disturbed except for a new interment. Yet with so little use cemetery turf is not as a rule good, and like the park turf the main reason for failure is too close clipping and too little fertilizer or wrong fertilization.

The old time cemeteries and those of the 90's present a real problem because they are usually situated on thin worn out sandy soil, overlying a gravel subsoil, and exposed to wind and the sun rays. In addition many have the lots raised from eight inches to a foot above the drives and paths, and are maintained with small endowments or smaller municipal appropriations.

The sites for the more modern cemeteries were chosen because of their landscape beauty

and appropriateness for the dignified and religious atmosphere. These cemeteries have reasonably good soil, trees to break the drying winds and are void of raised lots or graves. The endowments are sufficient for a good standard of maintenance.

It is necessary that the above statements of facts should be fully understood and appreciated. Also, that the following general rules for cemetery turf culture should be followed with modifications to suit the immediate problem, when one prescribes cultural treatment for cemetery turf.

Turf is very necessary to the cemetery, every one will agree, and the greener and healthier it is the better.

The most neglected portion of a cemetery is the undeveloped area, usually grown to weeds, poverty grass or brush. Such areas should be plowed and kept in cover crop until needed for lots. The cost of two cover crops each year with a small amount of fertilizer will pay large dividends later in fine turf and low maintenance cost. Cover crops such as cowpeas, soy-beans, or buckwheat may be grown in the summer and rye during the winter. Such a rotation of crops if grown for a

few years will improve the soil, look better than a neglected field and prevent the growth of weeds which might scatter seed on the cemetery turf.

If the sunken walks and drives are filled to a level of the lots the drying of the turf will be lessened and the general appearance of the cemetery improved.

Frequent and close clipping of cemetery turf causes it to become open and to lose much soil moisture by evaporation, especially if the turf is growing over gravel or sand. Too close clipping is a common error.

A grass seed mixture that is suitable for the soil should be adopted for the cemetery and no other used. Such a rule will assure uniform texture to the turf and one that can be fertilized the same throughout. Chewings fescue, Kentucky blue grass and Rhode Island or Colonial bent are basic grasses adapted to cemeteries. German and creeping bent are of doubtful value because of the dry soil conditions that usually prevail. They could be used in some of the modern cemeteries that have good soil.

A fertilizer program favoring the basic grass that is the healthiest should be adopted and

strictly followed. For cemeteries on sandy soil a 6-12-4 fertilizer applied in the spring and fall should give good results.

All leaves and humus should be composted and not burned, for top-dressings of loam or compost are very beneficial to turf on sandy soils. A large compost pile, if it is used, will greatly improve the physical texture of the soil.

No cemetery should be without a large turf nursery to provide turf for patching and the sodding of graves. The nursery should be well kept at all times, and located on soil that will not crumble away when the sod is lifted.

If a wild grass that makes good turf creeps into the lots, tame it and encourage it to grow. Turf is what is wanted and not a particular species of grass. Rhode Island bent and many bent species very often volunteer in turf. The use of acid reacting fertilizers is much more likely to encourage desirable native grasses to grow than fertilizers that give an alkaline reaction.

# XIII

## USEFUL TABLES

### Table IX—Amount of Compost or Loam Top-Dressing.

| *Depth of top-dressing in.* | *Amount in cubic yards required for* 1000 sq. ft. | 10 sq. rds. | ¼ acre | *1 cubic yard will cover* sq. ft. | sq. yd. | sq. rd. |
|---|---|---|---|---|---|---|
| ¼ | .77 | 2.26 | 8 | 1296 | 144 | 4.7 |
| ⅜ | 1.16 | 3.39 | 12 | 864 | 96 | 3.1 |
| ½ | 1.54 | 4.46 | 16 | 648 | 72 | 2.4 |
| ⅝ | 1.92 | 8.4 | 22.5 | 518 | 57 | 1.9 |
| ¾ | 2.21 | 10.8 | 24 | 432 | 48 | 1.5 |
| 1 | 3.08 | 13.3 | 33.5 | 324 | 36 | 1.2 |

### Table X—Spread of Fertilizer

| *Recommended rate per acre lbs.* | *Equals Pounds per* 1000 sq. ft. | 10 sq. rds. | 5000 sq. ft. | ¼ acre |
|---|---|---|---|---|
| 200 | 4½ | 12½ | 23 | 50 |
| 250 | 5¾ | 15 | 28¾ | 62½ |
| 300 | 7 | 19 | 34½ | 75 |
| 500 | 11½ | 31 | 57½ | 125 |
| 700 | 16 | 43 | 80½ | 175 |
| 900 | 20½ | 50 | 104 | 225 |

## Table XI—To Help Visualize Various Areas.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 sq. rod = | 16½′ | x | 16½′ | or | 10′ | x | 27′ | or 8′ x 38′ |
| or 272.25 sq. ft. | | | | | | | | |
| 10 sq. rods= | 52′ | x | 52′ | or | 70′ | x | 39′ | or 100′ x 27′ |
| or 2722.5 sq. ft. | | | | | | | | |
| 1000 sq. ft. = | 33′ | x | 33′ | or | 25′ | x | 40′ | or 60′ x 17′ |
| or 100 x 27 | | | | | | | | |
| 5000 sq. ft. = | 70′ | x | 70′ | or | 40′ | x | 125′ | or 90′ x 55′ |
| or 100 x 50 | | | | | | | | |
| ¼ acre = | 105′ | x | 105′ | or | 60′ | x | 181′ | or 150′ x 72′ |
| or 10890 sq. ft. | | | | | | | | |
| 1 acre = | 208′ | x | 208′ | or | 300′ | x | 145′ | or 400′ x 109′ |
| or 43560 sq. ft. | | | | | | | | |

## Table XII—Grass Seed Data.

| *Variety* | *Weight of seed legal bushel* | *Weight of seed actual bushel* | *Approximate number in one pound pure seed* | *Purity of good seed* |
|---|---|---|---|---|
| | | *lbs.* | | *%* |
| Bents ..... | — | 16–24 | 6,000,000 | 70 |
| Bermuda grass | — | 30–36 | 1,775,000 | 85 |
| Canada blue-grass ..... | 14 | 18–24 | 2,495,000 | 85 |
| Crested Dog's tail ..... | — | 30 | 862,000 | 85 |
| Chewings Fescue .... | — | 22–25 | 700,000 | 95 |
| Domestic Rye | — | 23–25 | 317,000 | 90 |
| English Rye.. | — | 23–33 | 226,800 | 98 |
| Italian Rye .. | 20 | 23–30 | 226,800 | 95 |

| *Variety* | *Weight of seed legal bushel* | *Weight of seed actual bushel* | *Approximate number in one pound pure seed* | *Purity of good seed* |
|---|---|---|---|---|
| | | *lbs.* | | *%* |
| Kentucky blue-grass ..... | 14 | 14–28 | 2,150,000 | 85 |
| Meadow Fescue .... | — | 20–30 | 226,800 | 90 |
| Orchard grass. | — | 12–16 | 521,600 | 85 |
| Red Fescue .. | — | 20–27 | 545,000 | 95 |
| Red Top .... | 14 | 18–40 | 4,990,000 | 96 |
| Rough Stalked meadow ... | 14 | 20–28 | 2,540,500 | 85 |
| Sheeps Fescue | — | 22–25 | 682,500 | 90 |
| Timothy .... | — | 40–48 | 1,135,000 | 90 |
| White clover.. | 60 | 60–65 | 680,500 | 98 |

From the above table it may be seen, for example, that a mixture containing Kentucky blue-grass 6 parts, Rhode Island bent 4 parts and Red top 1 part, by weight, is changed from a 6-4-1 ratio to a 2.5-4.8-1 ratio if the actual number of seeds are considered. The latter is the true proportion of the various seeds.

Rates of seeding, and correct amounts of various grass seeds to use to give a desired turf can also be calculated from this table.

TABLE XIII—SHOWING THE PERCENTAGE OF VIABLE SEED IN A MIXTURE OR SINGLE GRASS SEED OF KNOWN PURITY AND GERMINATION.

| *Purity of mixture* | *Percent. of Germinating Seed* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *70* | *73* | *75* | *78* | *80* | *83* | *85* | *88* | *90* | *93* | *95* | *98* |
| 70..... | .49 | .511 | .525 | .546 | .56 | .581 | .595 | .616 | .63 | .651 | .665 | .686 |
| 73..... | x | .533 | .548 | .569 | .584 | .606 | .620 | .646 | .657 | .679 | .694 | .715 |
| 75..... | x | x | .553 | .585 | .60 | .623 | .638 | .660 | .675 | .698 | .713 | .735 |
| 78..... | x | x | x | .609 | .624 | .647 | .663 | .686 | .702 | .725 | .741 | .763 |
| 80..... | x | x | x | x | .64 | .664 | .68 | .704 | .72 | .744 | .76 | .784 |
| 83..... | x | x | x | x | x | .689 | .706 | .730 | .747 | .771 | .789 | .813 |
| 85..... | x | x | x | x | x | x | .723 | .748 | .765 | .781 | .808 | .833 |
| 88..... | x | x | x | x | x | x | x | .774 | .792 | .818 | .836 | .862 |
| 90..... | x | x | x | x | x | x | x | x | .81 | .837 | .855 | .882 |
| 93..... | x | x | x | x | x | x | x | x | x | .865 | .884 | .911 |
| 95..... | x | x | x | x | x | x | x | x | x | x | .903 | .931 |
| 98..... | x | x | x | x | x | x | x | x | x | x | x | .96 |

## EXAMPLES SHOWING HOW THIS TABLE CAN BE USED

*Question 1*—How much viable seed in a mixture guaranteed as 85% pure, germination 90%?

*Answer*—Under 90 opposite 85 read .765 or 76.5% of the weight is pure seed.

*Question 2*—Is seed guaranteed 70-75 at 45c per pound cheaper than 90-95 at 55c per pound?

*Answer*—Under 75 opposite 70 read 52.5%

.525 lb. @ 45c = 85c for one pound of viable seed.

Under 95 opposite 90 read 85.5% .855 lb. @ 65c = 76c for one pound of viable seed.

*Question 3*—How much more of the 70-70 mixture is it necessary to purchase to obtain an amount of viable seed equal to that in the 90-95?

*Answer*—Percent of viable seed in a 90–95 mixture is 85.5%

Percent of viable seed in a 70–75 mixture is 52.5%

a difference of 33.0%

or 1/3 more.

*Question 4*—How much Kentucky blue-grass seed guaranteed 85-85 is necessary to equal German bent 75–85?

*Answer*—Under 85 opposite 85 read 72.3%. Under 85 opposite 75 read 63.8%.

From table XII we find one pound of pure German bent contains 6,000,000 seeds.

One pound of the sample contains 6,000,000 x .638 or 3,828,000 viable seeds.

One pound pure Kentucky blue-grass seeds contains 2,150,000 seeds.

One pound of the sample contains 2,150,000 x .723 or 1,554,450 viable seeds.

As 3,828,000 is 2.46 x 1,554,450 the answer to the problem is 2.46, or 2.46 pounds of Kentucky blue-grass for each pound of Bent.

## Examples how Table XIV May be Used

*Question 1*—How much of each, sulphate of ammonia guaranteed 20½ nitrogen, superphosphate 10%, and muriate of potash 48% is required to make a 12-6-4 fertilizer.

| | | | |
|---|---|---|---|
| *Answer*—Under 12 opposite 20½ lbs. ammonium sulphate | read | 58½ | = |
| Under 6 opposite 16 lbs. superphosphate | read | 38 | = |
| Under 4 opposite 48 lbs. muriate of potash | read | 8 | = |
| | | 104½ lbs. | |

Larger or small quantities of the mixture may be obtained by using multiples of the answer.

*Question 2*—A 12-6-4 fertilizer is desired using castor bean pomace 5-1½-1 and inorganic fertilizers. How much of each fertilizer is needed?

## Table XIV—Table for Mixing Fertilizers.

From this table one can determine at a glance the amount in pounds of a fertilizer material required to meet a certain specified formula.

| *Guaranteed available plant food units* | *Units of plant food desired in formula* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *7* | *8* | *10* | *12* | *14* | *16* |
| 1 .... | 100 | 200 | 300 | 400 | 500 | 600 | 700 | 800 | 1000 | 1200 | 1400 | 1600 |
| 1½.... | 67 | 133 | 200 | 267 | 333 | 400 | 467 | 533 | 667 | 800 | 933 | 1067 |
| 2 .... | 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 500 | 600 | 700 | 800 |
| 2½.... | 40 | 80 | 120 | 160 | 200 | 240 | 280 | 320 | 400 | 480 | 560 | 640 |
| 4 .... | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 250 | 300 | 350 | 400 |
| 4½.... | 22 | 44 | 67 | 89 | 111 | 133 | 150 | 178 | 222 | 267 | 311 | 355 |
| 5½.... | 19 | 37 | 54 | 72 | 90 | 109 | 127 | 145 | 182 | 209 | 254 | 291 |
| 7 .... | 14 | 27 | 43 | 57 | 71 | 86 | 100 | 114 | 143 | 171 | 200 | 228 |
| 8 .... | 12½ | 25 | 37½ | 50 | 62½ | 75 | 87½ | 100 | 125 | 150 | 175 | 200 |
| 9 .... | 11 | 22 | 33 | 44 | 56 | 67 | 78 | 89 | 111 | 134 | 156 | 167 |
| 11 .... | 9 | 18 | 27 | 36 | 45 | 55 | 64 | 74 | 91 | 109 | 127 | 145 |
| 14 .... | 7 | 14 | 21 | 29 | 30 | 36 | 50 | 57 | 71 | 86 | 100 | 114 |
| 16 .... | 6 | 12 | 19 | 25 | 31 | 38 | 44 | 50 | 63 | 75 | 88 | 100 |
| 18 .... | 5½ | 11 | 17 | 22 | 28 | 33 | 38 | 44 | 56 | 67 | 78 | 89 |
| 19 .... | 5 | 10 | 16 | 21 | 26 | 32 | 37 | 42 | 53 | 62 | 74 | 84 |
| 20½.... | 5 | 9½ | 15 | 19½ | 24½ | 29½ | 34½ | 39 | 49½ | 58½ | 69 | 78½ |
| 22 .... | 5 | 9 | 14 | 18 | 23 | 27 | 32 | 36 | 46 | 55 | 64 | 73 |
| 25 .... | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 40 | 48 | 56 | 64 |
| 45 .... | 2 | 4 | 7 | 9 | 11 | 13 | 16 | 18 | 22 | 27 | 32 | 36 |
| 48 .... | 2 | 4 | 6 | 8 | 10 | 11 | 15 | 16 | 21 | 25 | 30 | 34 |

12-6-4 less 5-1½-1 (100 lbs. castor pomace) = 7-4½-3 to be made up with inorganics.

Under 7 opposite 20½ read 24½ = number pounds ammonium sulphate.

Under 4½ (by interpolation) opposite 16 read 28 = number pounds superphosphate.

Under 3 opposite 48 read 6½ = number pounds potash.

| *Answer* | *Guaranteed* N–P–K | *Units available* N–P–K |
|---|---|---|
| 100 lbs. castor bean pomace | 5–1½–1 | 5–1½–1 |
| 34½ lbs. ammonium sulphate | 20½ N | 7–0 –0 |
| 28 lbs. superphosphate ... | 16 P | 0–4½–0 |
| 6½ lbs. muriate of potash.. | 48 % K | 0–0 –3 |
| 169 lbs. | | 12–6 –4 |

169 lbs. is a sufficient amount for one application on an area of ten thousand square feet.

The experiment station of nearly every state publishes annually a report showing the analysis, and trade value of all fertilizers sold within the state. This publication is useful and valuable to anyone who purchases fertilizers. It may be obtained free of charge by writing to the Experiment Station of your state.

## Data Concerning My Lawn.

Fill in data early in the spring and compare with the condition in the fall.

| | *North side* | *East side* | *South side* | *West side* |
|---|---|---|---|---|
| Area | | | | |
| Topsoil | | | | |
| Subsoil | | | | |
| General health of the turf and number of weeds growing | | | | |
| Fertilizer used | | | | |
| Date used | | | | |
| Amount used | | | | |
| General remarks | | | | |

## Seeding Record.

Date seeded ..... Reseeded .....
Seed used .....
.....
Purchased from .....
Date ..... Amount ..... Cost .....
General remarks .....
.....
.....

FERTILIZER RECORD

*Date applied* *Rate of application* *Kind of fertilizer*

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Results .....

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The fertilizer was purchased from.....

Amount purchased.....Cost.....

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